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HOUSE OF COMMONS COMMITTEE.

WEDNESDAY, MAY 9.

(*Before Mr.* D. R. PLUNKET, *Chairman; Mr.* FOLJAMBE, *Mr.* STARKEY, *and Mr.* COURTNEY.)

THE GASLIGHT AND COKE COMPANY BILL.

(*Continued from p.* 912.)

Mr. *Lewis Angell*, examined by Mr. MICHAEL.

I am a member of the Institution of Civil Engineers, and also engineer to the West Ham Local Board of Health. I reside in Stratford. The Bromley works of The Gaslight and Coke Company are situated in Canning Town, in the parish of West Ham. The nuisance is one of the most intolerable I have ever experienced. The West Ham Local Board have had complaints from residents a mile and a half to two miles from the works. There is a population of 100,000 people in West Ham, besides the surrounding populations of the adjoining districts. Those complaints have been received from all classes, from the highest to the lowest. We have also had memorials from the Metropolis on the other side of Bromley and Bow. We have had private letters sent to us, and also the officials of the populous district have communicated with us, in order to put the law in force. We have been complained of very seriously because we have not put the law in force, it being alleged that the board have not taken sufficiently energetic means to suppress the nuisance. We have had an influential memorial from residents in the metropolitan district, signed by the Vicar of Bow, Sir Edmund Hay Currie, and people of that class. I have traced the nuisance to the gas-works. Proceedings are pending at the present time, by the local board, against the gas company in the superior courts. The West Ham Gas-Works, also within our district, do not create any nuisance whatever. I have heard no complaint, nor have I at any time traced anything to them. I believe they are not under any obligation to reduce the quantity of sulphur to 15 or 20 grains. They use the oxide of iron process. They used lime some few years ago, and then there were occasional complaints; but since they have given up lime there have been no complaints. I have not heard any complaints that their gas is more impure than the gas supplied by The Gaslight and Coke Company. I burn the West Ham Company's gas, and have not found any bad consequence resulting either to property or health. I have not seen any evidence of the West Ham gas producing those results which are said to arise from having a larger quantity than 20 grains of sulphur. My gilt frames are the same as average gilt frames, and not in any way darker than those in other districts. There is no injury to property which I have traced to sulphur in gas. If that injury had arisen from sulphuric acid, it would hardly have occurred without my noticing it.

Cross-examined by Mr. O'HARA: I live at the Grove, Stratford, which is about a mile and a quarter, I should think, from the gas-works. I have been woke up in the early morning by the smell; it is so conspicuous and intolerable that there is no mistaking it.

Mr. O'HARA: As to these proceedings in the superior courts, do you know who advised them? How did you begin them?

Witness: In consequence of the complaints which were made. It is one of the standing discussions at our board; there is scarcely a meeting at which this matter is not mooted. Our clerk is the solicitor to the board, and he was instructed to take proceedings against the company, and the board certainly entertain the hope that those proceedings will be successful. Of course, we shall be quite satisfied if the stink is abated.

By Mr. ROUND: The company's officials have told me that they have adopted the very best practical process for purification—namely, the process prescribed by the Referees—and that they can do no more. They admit the nuisance, but they say that they can do no more than they are doing to abate it. I have been over the works repeatedly, and have been shown what they were doing, although I am not sufficiently a gas engineer to be able to form any judgment about it; but I considered they were doing all they could.

By the COMMITTEE: The West Ham parish is a very extensive one. I am living about half a mile from the West Ham works, and therefore very much nearer those works than The Gaslight and Coke Company's works. The West Ham works are in the midst of our population. There is a very great difference in the relative size of the works. The West Ham Gas-Works would perhaps be about one-fourth of the size of the Chartered Company's works. They supply a large district out by Woodford and Loughton. We suffer no inconvenience whatever from the West Ham Gas-Works.

Mr. *Richard Henn Collins*, examined by Mr. MICHAEL.

I am a barrister-at-law, and have resided at 32, Redcliffe Gardens since July, 1873. I was absent from London on circuit during the greater part of the summer of that year, and then went away for the long vacation. After my return I perceived a most offensive smell. I cannot say that I traced where it proceeded from, but I was told. I observed the smell particularly in the mornings, often about five o'clock. I have been awakened by it. I have gone from one side of the house to the other to see whether it was on both sides of the house. I found it came in through the windows on one side, and then I went to the other side of the house, and found it came in through the windows on the other side. It was about as unpleasant a smell as one can possibly imagine. In the summer of 1874 the smell was so very bad that I seriously thought of leaving my house. I frequently spoke to the builder who owns most of the houses in the place, and told him I must try to get some joint action taken by the householders in the place to indict the company, or to get the vestry to remove it, otherwise I said that I, and no doubt others, would find it necessary to give up our houses.

Cross-examined by Mr. O'HARA: I went to see Mr. M'Clymont, and told him that what we wanted was joint action, to put down this nuisance by indictment.

Mr. O'HARA: Have you ever looked into the Gas Act?

Witness: No, I cannot say that I have.

Why would they not take joint action?—I understood they were taking joint action, or that the vestry were going to take it, and I am not sure that they did not begin.

Supposing they were by indictment to put an end to this nuisance, would that satisfy you?—I would not be particular as to how it is put an end to.

You are not particular whether it is done here or in Westminster Hall?—No; on the contrary.

By the COMMITTEE: I have repeatedly tried to stir the inhabitants up, but always in the hope that some action would be taken by the landlord particularly, because he owns an immense tract of new building land all about there, and I thought he would be a very likely man to set the thing going.

The COMMITTEE: Have you any idea why he discontinued the proceedings which he began?

Witness: I should state that I am not quite clear whether the proceedings ever got so far as being actually commenced. He told me that the gas company were themselves trying to get rid of the obligation to make this stench, and that is the last thing I heard about it.

The CHAIRMAN (addressing Mr. Michael) said: Perhaps you will be kind enough to answer this question. How would it be supposing the local authority indict for a nuisance—will their statute protect the company? Is the indictment to be tried first, and then, in the event of its succeeding, and not until then, the Referees are to alter the limit?

Mr. MICHAEL: That would not, with great deference, touch the Referees at all.

The CHAIRMAN: I want to know whether it requires it to be such a nuisance as would be proved by a successful indictment?

Mr. MICHAEL: I shall be glad to have an opportunity of putting you in possession of what course must have been in the minds of the gas company when they consented to such a clause as that—perhaps it was forced upon them—or what would be the logical sequence of such a clause. Supposing gentlemen were appointed as Referees who were all practically acquainted with the manufacture of gas, then, in other words, this clause says: You shall impose such a limit, judged of by your practical experience in gas-making, as will allow the gas company to manufacture gas without creating a nuisance. There is nothing provided that will enforce the Referees (it is a matter for their private opinion) to say, "We think you can, if you so will, reduce the quantity of sulphur to 5 grains." There is no appeal given.

The CHAIRMAN: Perhaps it is my own fault that I have not made clear what I was in doubt about. Do you consider that it is entirely in the discretion of the Referees to say what is and what is not a nuisance? For instance, suppose Mr. Collins had himself applied to the Referees, or suppose Sir Edmund Currie had gone on behalf of 50,000 people whom he spoke of, would the Referees then, do you think, have it in their discretion to say whether it amounted to such a nuisance as was contemplated by this section without further proof?

Mr. MICHAEL: The view I take of it (it matters nothing what another tribunal may say) is that it leaves this matter entirely untouched. It does not say that a nuisance shall be created, but it says that the gas shall be purified in such and such a way. The only restriction is that they shall not impose such a limit as that it cannot be done without creating a nuisance, which is another point entirely. That you may prove before a tribunal that a nuisance is created, does not at all touch the discretion of the Referees. There is no obligation on them to say, "You shall conduct it by such and such a process;" so that, although you may have one thousand injunctions, it does not touch the discretion of the Referees at all. They will say, "It is simply for you to decide which plan you will adopt."

The CHAIRMAN: I think you hardly see my point. What we want to arrive at is whether it is not possible for the Referees to be informed of these things, and as soon as possible then to alter and remedy them if they think fit. Suppose there was a successful indictment, and the Referees were aware of that, and they went to the gas company and ascertained that all due precaution had been taken, would you consider that they would be obliged to alter the limit of restriction.

Mr. MICHAEL said the indictment did not alter the state of things at all, seeing that they must have known that there was a nuisance at that time in the locality, and yet they had insisted on some kind of process which would inevitably produce a nuisance. There was no power of appeal from the Referees. Supposing there were an indictment for a nuisance; then there would be an injunction by the Court of Chancery, after indictment, to prevent the company carrying on purification by lime, because it was quite clear that the High Court of Chancery had nothing whatever to do with the defence, which merely raised the point that it was impossible to do it in any other way. All the decisions of the Courts came to one thing. It was nothing to the Court that it could not be done in any other way. In the case of injunctions with reference to the pollution of rivers by sewage and other matters, where the local authorities had said, "You cannot prevent us pouring sewage into the river, because there is no other course open to us, and, therefore, you will cause a destruction of health to the whole of the inhabitants, by preventing us carrying out the only available plan," the Court had said, "It is nothing to us; all we

can do is to restrain you from committing a nuisance." Following that out in the present case, the Court would most likely say, "Before we grant an injunction you must proceed at law, and prove that there is a nuisance." Supposing that the nuisance was proved to the satisfaction of the Court, it would be in the discretion of the Court to act in accordance with all their decisions, and to say, "You shall not use lime." But what was the result to the Referees? If the Referees were to continue the restrictions, as far as the present state of knowledge was concerned, as lime was the only mode—if the evidence was to be believed—by which the gas could be purified at all, there were no means of enforcing it on the Referees, because the nuisance had been created by the mode which had been adopted. They would say, "There is nothing in any way imposed upon us, by the Act of Parliament, to dictate to you the means to be adopted to prevent a nuisance. All we have to do is simply this. The Act says this: 'You shall not put more than 20 grains of sulphur in your gas;' but you may use whatever means you like. We believe it can be done without creating a nuisance, and there is an injunction against this mode; an indictment does not touch it at all, and we believe you can do it without creating a nuisance."

The CHAIRMAN: Do you mean by an alternative process?

Mr. MICHAEL said by any process. It was not for the Referees to dictate what the process should be. If there were anything to say that the Gas Referees were obliged to show the gas company how their restrictions could be carried out, and that only that process should be used, then there would be relief to the gas company; but now they had an arbitrary power, and it was entirely within their discretion to say what it should be. If they had ever indicated that there was another process which might be adopted instead of the lime, in order to avoid that nuisance, then the company's case would be very much weakened. But they had never indicated any other way of doing it.

The CHAIRMAN: I think, Mr. Michael, that you hardly see my difficulty. One would think the obvious way of remedying this, if there be a nuisance, is that the people so affected, as so many preliminary steps are required for the construction of this Act, should go to the Referees, and say, "We have a grievance," and that then the Referees, among whom there happens to be an experienced gas engineer——

Mr. MICHAEL: No, sir; pardon me, there is not.

The CHAIRMAN: That is another question. At any rate, they must be supposed to be competent and impartial persons. One would suppose that the next step would be that they should inquire at the gas-works whether there is a nuisance, the cause of which can be cured by an improved system; but if they find that all the precautions they can suggest are being taken, and that still the company are under the danger of a prosecution at any time, or an indictment, is it conceivable that they would act so unreasonably as to give the company no alternative?

Mr. MICHAEL: It is not only conceivable, but we shall prove to you that it is absolutely the fact. We have placed everything at the disposal of these gentlemen; we have spent thousands of pounds to carry out their suggestions. They have never said to us, "Use the A, B, C, or D process," or any process, that we have not adopted. We do not find them coming here and saying, "If you will only modify this process you will prevent a nuisance." That is exactly our position.

The CHAIRMAN: You say you do not consider the word "nuisance" in this section is a technical term. You do not mean to say such a nuisance as would have to be proved by indictment, but you consider it to be used in the ordinary and popular sense.

Mr. MICHAEL: I am quite willing to take it either way; but I believe it is the legal sense of a nuisance. I do not know whether you had in your mind the definition of a nuisance which has been held under the Public Health Act, namely, that of injurious to health.

The CHAIRMAN: Yes.

Mr. MICHAEL: I do not think it was intended to be confined to that.

The CHAIRMAN: I am thinking of a common ordinary nuisance for which you may indict at common law.

Mr. MICHAEL: There has been rather a strict definition given to "nuisance" under the Public Health Act. I think it is wider than that.

The CHAIRMAN: It would hardly apply unless there was an interpretation clause.

Mr. COURTNEY: Your situation may be analogous to that of a Board of Health who are the owners of a piece of ground between two mills; they are not allowed to turn their sewage into the stream because of injuring the stream; they are obliged to get rid of it somehow or other. But in this case you are under the orders of the Gas Referees, who, by clause 36 of your Act, are instructed to prescribe and certify the maximum amount of impurity in the gas, subject to the condition that their orders shall not require you to make a supply of gas continuously, so as to occasion a nuisance. That is a statutory restriction upon their order. Has it occurred to you that you might possibly go to the Court of Chancery and apply for an injunction to restrain them issuing a certificate which imposed upon you a duty which could not be fulfilled without creating a nuisance?

Mr. MICHAEL: It has occurred to other parties, although it has not occurred to us, because, as I venture to say, there is an entire loophole in the whole matter. It all comes to this: What is the process? Are you tied up absolutely to that process or not? It involves an entirely different matter.

Mr. COURTNEY: That will be a question of evidence.

Mr. MICHAEL: It does not say that they shall prescribe a process which absolutely and indispensably will not create a nuisance.

Mr. COURTNEY: That is quite true, so you might be under the difficulty of having to prove a negative before the Court of Chancery, supposing you went there.

Mr. MICHAEL: We should have a double onus thrown upon us of proving a positive and a negative. I think in the Tunbridge Wells case, and other analogous cases, it has been held that the Court of Chancery has nothing whatever to do with the process, and that all they have to do with is to lay down fixedly the law, "You shall not create a nuisance." It is no defence whatever to say that you do not know of any process by which this can be done without creating a nuisance.

Mr. COURTNEY: That is quite a different point. My question is whether you could not yourself institute some process to restrain the action of the Referees.

Mr. O'HARA: To relieve you from committing a nuisance.

Mr. MICHAEL: What can be the difference between our proving it to the Court of Chancery and our proving it to the committee? If this involves a hardship upon us, and involves the necessity of the same proof that we should have to give to the Court of Chancery, is it not right that we should come to you, and ask you to legislate for us, and give us that relief which you say we ought to be permitted to obtain from the Court of Chancery? It is by the action of the Legislature that the difficulty has arisen; therefore, is it not better for us to come to you and ask you so to deal with the law, with better knowledge, so as to relieve us from being between the two stones under the action of which we are being ground to powder?

Mr. O'HARA: The 30th section prescribes the duty which the Referees have to perform, coupled with certain conditions. The moment the Referees perform that duty, and forget the conditions, they are acting *ultra vires*. Let the company refuse to obey the order of the Referees when that order is *ultra vires*, and then who will enforce the penalty? That is the way to test it. In one case you propose to relieve the company from being obliged to obey; in the other case I say let the company defy those who are doing what is illegal and *ultra vires*.

Mr. MICHAEL: That is a very nice state of things. Here you are representing the Metropolitan Board of Works, who have passed a law, and they recommend the gas company to place the law at defiance. They have got a pecuniary interest, because they get the penalties of our breaking the law. They advise us to break the law in order to avail themselves of the penalties.

Mr. O'HARA: We say that the Referees act thoroughly within the law, and that there is no breach of the law, and you dare not defy them.

The CHAIRMAN: May I ask by which side the Referees will be called, because it seems to me that this Act of Parliament contemplated that the Referees might carry out its provisions according to the intention of the Act?

Mr. MICHAEL said the course which had usually been adopted was that neither side should call the gentlemen exercising such functions, but that the committee should themselves call them.

Mr. ROUND said he was instructed to appear by the Board of Trade, who had no opinion whatever upon the merits of this Bill, as to whether it was proper that the restriction which was placed last year upon the company should be repealed now or continued. All they felt was that, so long as their officers, to whom certain duties had been entrusted, exercised those duties to the best of their ability, and in the discharge of them had not laid themselves open to any imputation of *mala fides* or corruption in any way, it was a matter of indifference to them. He did not himself propose to put the Referees into the box, as he did not conceive it was at all necessary for the purpose of defending what they had done. They were simply discharging their duty, according to what seemed to them to be the mode defined by the Act of Parliament, and they had nothing whatever to do with what the results might be. Of course, if the committee thought that the Referees could give any information, they, in the exercise of their discretion, would take what steps they thought right.

The CHAIRMAN: What do you suggest is the check upon the Referees in the discharge of their duty? I suppose they would not be re-appointed next year if there were complaints made to the Board of Trade. Is that the remedy, or what is it?

Mr. ROUND said the Referees might be bound, in the exercise of their discretion, to see whether or not, in their judgment, everything had been done that could be done. It did not devolve upon them either to suggest or to dictate to the company any particular process by which the purification could be carried out. The Referees might be entitled to say, "There is not uniformity in your system; you adopt one process at one branch, and another process at another branch. We have formed the opinion that at A, where you have adoped a certain process, there have been no complaints of a nuisance; but at B, where you have adopted the same process, or have adopted a different one, there are complaints." The Referees might say there was want of uniformity.

Mr. MICHAEL: Do you say that that is the case?

Mr. ROUND: I am merely putting that as an illustration.

Mr. MICHAEL: If so, I suppose the Referees will be called to prove it.

Mr. ROUND said the Referees were no partisans in any way whatever: they were simply discharging a public duty. The Board of Trade thought it was incumbent upon them, if the conduct of the Referees was inquired into, to see that they should not be unprotected; but their view was that they had nothing to do with the question raised by the Bill or otherwise. They had appointed good men, as they thought, and until their conduct was impugned in any way, it was not proposed to call them.

The CHAIRMAN: We do not in the least impute any misconduct to them, but the phase which the case seems to take now is this: On the one hand the gas company say, "It is impossible for us to conform to your requirements without creating a nuisance," and, on the other hand, the public say, "It is impossible for us to endure this smell." The Act of Parliament says, "You are not to inflict such a limit of impurity as will create a nuisance," and what we want is to have an explanation from these public officers.

Mr. ROUND said the duty imposed upon the Referees was to reconcile two things—viz., a certain maximum amount of purity of gas coupled with no nuisance.

Mr. MICHAEL hoped that it would not be thought that he imputed any kind of misconduct on the part of the Referees, as he begged to disclaim that most entirely.

The CHAIRMAN requested the Referees to be in attendance on the following day.

Mr. ROUND said he ventured to think that the whole case should be concluded on the part of the promoters, and that then any explanation which the Referees could give should be given. If the Referees were called at that stage, it would be practically giving the company an opportunity of shaping their case so as to be a reply upon the Referees.

Mr. MICHAEL: If there is anything presented by the Referees against us, ought we not to be able to answer any allegation they may make? Is it not your wish that the committee should hear the whole case, and know the whole truth of the matter?

The CHAIRMAN said the present application was made on behalf of a company who were asking for an alteration in the Act of Parliament under which they were working. It turned out in the course of the inquiry there was a state of affairs apparently existing which had not been explained, and the committee thought that the people who could best explain it were the Referees themselves, the question being as to the exercise of their discretion as public servants. The Referees were the servants of the Board of Trade, and, therefore, they did not come as partisans for one side or the other, but only to explain their conduct. There was no imputation of *malfeasance* upon them; but there was a state of affairs which the committee did not quite understand, and which required clearing up.

THURSDAY, MAY 10.

Lord *Charles Thynne*, examined by Mr. MICHAEL.

I have resided at Redcliffe Gardens since the year 1870. When I first lived there I remarked that the neighbourhood was so singularly free from any bad smell that I determined to purchase the house. After my return from Ireland in 1873 we were very much annoyed by a most disagreeable smell, that pervaded the whole house when all the doors and windows were closed. In consequence I wrote to the Metropolitan Board of Works, and complained to them upon the subject. A rigid examination was instituted in the sewers and drains, and it was found that no bad smell arose from that source. It was subsequently traced to the works at Fulham of the late Imperial Gas Company. I inquired there as to the source of the nuisance, and I was told it was the result of a process of purifying the gas, which had been changed in 1873. Up to the present time I have found that the nuisance has been of an unfailing and unendurable character; of course, it depends upon the quarter of the wind. When the wind is in the south or south south-east, which is in the direction of the Fulham station, I suffer from it very considerably, but not when it is in other quarters.

Cross-examined by Mr. O'HARA: I made a representation to the resident engineer of the gas company a few months ago. I took no further steps beyond calling upon the Metropolitan Board, because it seemed hopeless. They told me at the gas-works that it was due to a new process of purification.

Mr. *John William Mellor*, Q.C., examined by Mr. MICHAEL.

I have resided in St. George's Square since the end of 1866, and my house has been subject to bad smells at intervals ever since. I think recently the smell is rather worse. I usually perceive it when the wind is in the east. My house is on the west side of the square, and the smell comes straight across from the gas-works. I think I can remember about half a dozen instances in which the smell has been very bad in the night. I have been awakened, I think, three times myself by the force of the smell. I generally walk from my house to Westminster in the morning. I walk along the Grosvenor Road, and as soon as I get near the gas-works the smell is perceptible every day. The very bad smell of which I complain has only been perceptible in the night on about half a dozen occasions. It produces a suffocating feeling, but I cannot say that I have been sick, although it has made some of my children feel sick. I feel it chiefly with a moist atmosphere, undoubtedly. I have been to the gas-works to make inquiries, and ever since 1866 I have received assurances from the persons to whom I complained that the works would probably before long be taken out of London, and I, sincerely trusting that that might be the case, took no further steps until the letter was written which was read to the committee yesterday. I should like to say that the gas is manufactured in a low building, which, so far as I can see from passing, has open windows with wooden bars across. It occurs to me that the place in which these works are situated is a very bad one for the neighbourhood; and that is, I believe, the general feeling of the inhabitants of St. George's Square. Upon the night before that letter was written—it was written on the 23rd of November—I had suffered very much from this smell. There are 124 houses in St. George's Square, and I went to No. 124, the office of the trustees, to complain. As I was going there I met a friend, General Anstel, and I found he was going for the same purpose as I was. We compared notes, and I suggested that a strong remonstrance should be sent to the gas company. I saw Mr. Sclater-Booth, and afterwards we agreed to send the letter. At that time we were not aware that any Bill was about to be promoted by the gas company. I think very probably, if we had been aware of it, we should have had a meeting, and endeavoured to be represented upon the occasion, because this matter has been a serious nuisance to many of the inhabitants.

The COMMITTEE: Do you mean to say you would have supported the Bill?

Witness: That I cannot say. I am not sufficient chemist to know whether it is the fault of the gas company or not; but when the letter was written my strong impression was that it was owing to the negligent way in which the gas was purified. I am told by the gas company that I am wrong in that, but I thought it desirable the committee should know my view.

Mr. ROUND said that in conformity with the wish expressed by the committee, two of the Referees, Mr. Vernon Harcourt and Dr. Pole, were present, and were prepared to give the fullest information upon any subject on which it was desired.

The CHAIRMAN: As you were present yesterday when the idea arose of asking those gentlemen to attend, if you will be good enough to commence the examination, then we can ask them whatever we think necessary.

Mr. *Augustus George Vernon Harcourt* called.

The CHAIRMAN (to witness): I wish to say that we have not asked you to come here as a witness either in support of the Bill or against it; but we have thought that perhaps it would shorten the inquiry, and be the most convenient process, if you would throw some light upon the practical operations by which you execute your office under the clause of the Act.

Witness (in examination by Mr. ROUND): I was appointed one of the Gas Referees in 1862, in connexion with Dr. Pole and Professor Tyndall. The first step we took with regard to the carrying out of section 30 in The Gaslight and Coke Company's Act of 1876 was to put ourselves in communication with the engineers of that company. We visited the different gas-works, to observe what modes of purification were in use. With the exception of the small Silvertown works, which we had not to do with, we visited all the works shown on the map. The first notification we made as to how many grains of sulphur might be allowed, consistently with the non-creation of a nuisance, was in September, 1872. The maximum amount that we thought justifiable in prescribing was 20 grains for the suburban works of Bow and Beckton.

Mr. ROUND: How far may that be said to have been done with the assent, or, at least, without the dissent of the gas company?

Witness: We endeavoured, as far as we were able, to obtain the assent of the gas company.

May I say that you succeeded? Can you fairly say that they were parties to that maximum of 20 grains?—I do not know how far; I can say that their assent was not required, but we endeavoured to obtain it.

Was there any direct opposition on their part?—I believe it was understood that we were required to fix a maximum, and, as far as my memory serves me, the maximum prescribed by us was considered reasonable. The following are our certificates since 1872:—

Half-yearly Periods.	Suburban Works. Grains.	Urban Works. Grains.
Winter half year, 1872–3	20	—
March to June, 1873	20	—
June to September, 1873	20	25
Winter half year, 1873–4	20	30
Summer half year, 1874	20	25
Winter half year, 1874–5	20	25
Summer half year, 1875	15	20
Winter half year, 1875–6	20	25
Summer half year, 1876	15	20
Winter half year, 1876–7	20	25

For the urban works the amount of sulphur was only recorded for 1872 and 1873; a portion of it was not fixed, but from June to September, 1873, we prescribed the actual amount for both suburban and urban works. In prescribing the various amounts of purity we thought we were acting conscientiously and in the discharge of our duty, and that we were prescribing an amount that was reasonable and practicable to obtain. During the first four years—from 1872 to 1876—complaints about the nuisance were comparatively few and unimportant; there have been more complaints within the last six or nine months than during all the preceding period since we have been Referees. Shoreditch, Pimlico, Fulham, and Bromley are the four stations from which we have complaints.

Mr. ROUND: As to each and all of them, you have been asked by the Board of Trade to inquire into and make special reports, have you not?

Witness: We have visited them all.

Mr. MICHAEL: Would you kindly answer the question?

Witness: I believe it was not for the Board of Trade that we were asked to visit them in all cases. The reason I so limited my answer was, that I believe, in the case of the Pimlico works, it was a letter which was forwarded to us addressed by the solicitor, I think, of the gas company to us. It was not the Board of Trade who set us in motion in that case.

Mr. ROUND said he would confine the matter in the first instance to the Shoreditch case, and would read a letter, dated the 18th of October, 1876. It appeared that Mr. Walker, the vestry-clerk, addressed a letter to the Secretary of the Board of Trade, to the following effect:—

I am directed by this vestry to call the attention of the Board of Trade to the fact that a great and unbearable nuisance is caused by the operations carried on at the works of The Gaslight and Coke Company in Haggerston, which, it is alleged, arises from the mode of purifying the gas from lime, rendered necessary by the Gas Referees having prescribed a standard of purity which cannot be obtained without causing the nuisance complained of. The particulars are more fully set forth in the report (copy enclosed). I am to ask whether the Board of Trade are prepared to advise that the orders of the Referees may be so relaxed as to permit the nuisance complained of being discontinued, otherwise this vestry will have no alternative but to apply to the Court of Chancery to restrain the company from pursuing its operations.

[The report which appeared in the JOURNAL of Oct. 24, 1876, page 597, was read.]* That letter was signed Henry G. Sutton, Medical Officer, and E. Walker, Vestry-Clerk, and was sent to the Board of Trade, who addressed the following letter to the Referees, dated Oct. 20:—

Gentlemen,—I am instructed to transmit to you herewith a letter which has been received from the vestry of St. Leonard, Shoreditch, complaining of a nuisance caused by the works of The Gaslight and Coke Company at Haggerston, and to request that you will favour the Board of Trade with your observations thereupon.

To that letter, the following reply was received, signed by Mr. Vernon Harcourt, and addressed to the Board of Trade:—

I beg leave to acknowledge the receipt of your letter of the 20th inst. It shall have the attention of the Gas Referees, and we will send our observations thereon to the Board of Trade shortly. The Vestry-Clerk of St. Leonard, Shoreditch, having furnished us with copies of their letter to the Board of Trade, and its enclosure, I return the originals herewith.

On the 22nd of November, 1876, the following reply, signed by Mr. Vernon Harcourt and Dr. Pole, was sent to the Board of Trade. [See JOURNAL, Jan 2, 1877, page 17.]

Examination resumed: I formed my opinion from statements made to me at an interview at our office, at which the secretary of the company and the superintendent from those works were present; and from the account they gave of the nature of the nuisance, and from the statements that the smell which they considered had been objectionable was the smell of heated naphthaline. I also arrived at the conclusion, which was formed from inquiries upon the spot, that the nuisance arose from accidental miscarriage of the process of ventilating the purifiers, which had resulted in producing the high temperature in the oxide purifier, through which the air which is passed through the lime purifier is sent. The wooden sieves, I understood, had been burnt, and, as far as I could judge, the nuisance had been occasioned by that exceptional cause.

Mr. ROUND: I think prior to that the company had asked you to come and meet them upon the spot. This is a letter by Mr. Phillips, addressed to you, dated the 11th of October, 1876:—

Dear Sir,—Our engineers are experiencing difficulty in dealing with their foul lime, and notwithstanding all the pains they take, they are threatened with legal proceedings on the ground of nuisance. In the hope of being able to obtain some amelioration of your notification, the directors are very anxious that I should see you and your colleagues.

Then there was a meeting held, and you acceded to their request and went, did you not?

Witness: We visited Haggerston, as appears from this letter.

Mr. MICHAEL: You answered that letter on Oct. 17, 1876:—

I can meet you in town on any Monday, Wednesday, or Friday, that may be convenient to you. Shall it be next Monday, at our office, at eleven o'clock? I will write to my colleagues to endeavour to make an appointment for that day. I have written to our clerk to direct him to send you the six copies of our last notification, for which Mr. Bush has asked."

Witness: It was in consequence of that letter that the interview took place, at which Mr. Phillips, Mr. Clark, and, I think, also Mr. Evans, were present, and it was from the statements made at that meeting that I first formed the opinion that the nuisance was due to the miscarriage of the ventilating process.

Mr. ROUND: You told me what your opinion was. I only wanted to show how it was that you formed this opinion. Then, on the 24th, they write you this letter, signed by Mr. Phillips:—

While we were with you yesterday, the parish authorities of Shoreditch were at our works there, and, I am told, came to the determination to apply for an injunction to restrain us from the use of lime. I do not like to appear unduly pressing, but I cannot help thinking that your decision admits of no delay. A suspension of your order would allow us to use oxide of iron for the moment, and give you time to reconsider the whole question.

On the following day you answer that letter, writing to Mr. Phillips, and say:

We will reconsider the question of the difficulty of lime purification in London as soon as possible. I believe Dr. Pole will be in London before the end of the week. I wish to see the process of purification at Shoreditch, which is the subject of complaint. Friday, the 27th, would suit me, but if Mr. Clark has to attend your board meeting, I would postpone coming till Monday, the 30th; meantime I think it likely that the remedy lies in your own hands. Both from the account of the nuisance given by Mr. Evans and Mr. Clark, and from the fact that lime purification has been carried on for between two and three years without this outcry arising, I incline to think that the aëration of the purifiers is the cause of the nuisance. If the gas is thoroughly purged from ammonia before it enters the purifiers, and if the foul lime is got quickly into barges and sent away, I believe after much watching of the process that nuisance may be avoided.

Mr. MICHAEL: You have not visited the works then; it was a visit to your office that Mr. Phillips made?

Witness: It was an appointment to meet at our office in the first place.

Mr. MICHAEL: All this took place before the visit to the works?

Mr. ROUND: It is, nevertheless, the fact that you went there and witnessed the opening of one of those purifiers?

Witness: Yes; the interview you have referred to took place prior to the letter that you read.

You went there and saw one of these purifiers emptied?—Yes.

You had better explain what was the conclusion you arrived at when you saw it opened?—It was the conclusion stated in the letter—that the nuisance was due to a temporary cause, and then at the time of our visit the nuisance was very slight, and we found by inquiries among those who lived round the works that some had observed no nuisance, and that those who had observed the nuisance referred it very constantly to the period at which this over-heating of the purifiers had taken place.

Mr. ROUND: I think that explains Shoreditch, as far as I am able to deal with it.

Mr. MICHAEL said there were two letters which he thought ought to be read, of Nov. 6 and Nov. 9.

Mr. ROUND said he would read the letter from Mr. Vernon Harcourt to Mr. Clark, dated Nov. 6:—

The Gas Referees are desirous of witnessing the operation of opening and emptying a

* It is intended to reprint, in a pamphlet, the whole of the proceedings on this Bill and that of the Crystal Palace District Gas Company. This report, together with such portions of the correspondence as has recently appeared in the columns of the JOURNAL, will then be inserted *in extenso*.

lime purifier, as conducted at your works. The rate at which the purifiers become exhausted is probably known to you sufficiently to enable you to name one or two days between which we may choose. Friday next would be convenient to me, or the Monday following. Please address your answers to the Gas Referees at this office.

The letter of the 9th was written by Mr. Vernon Harcourt to Mr. Clark:—

I am obliged by your letters of the 7th and 8th. To-morrow (Friday) would have suited me; but I hear from Dr. Pole that he will be engaged, and I do not know whether Dr. Tyndall would be able to come, I think, therefore, it will be best to fix a day, if possible, sufficiently beforehand for us all to come. I understand that you have to change about three purifiers a fortnight, and think, therefore, that next Thursday or Friday (16th or 17th) another may be ready to be emptied. Please let me know as soon as you can whether you will be emptying a purifier on either of those days, and I will arrange with my colleagues. We should like to be present when the lid is raised. I think the difference between the upper and the lower part of each layer of lime depends on the accumulation of moisture in the upper part. Drier lime has more affinity for carbonic acid, wetter lime for sulphuretted hydrogen. If you can easily do so, I wish you would try the experiment of placing, on the second tier of sieves from the top, lumps of quick lime (from the size of a nut to that of a tennis ball) so that the sieves may be covered to an average depth of 1½ inch. I believe this layer will be thoroughly first hydrated and then carbonated before the purifier comes out, and if so it may be possible to have every other layer at least thus charged with dry lime and inoffensive when the purifier is emptied. Of course there will be holes in a layer thus formed. But I believe holes do no harm if they occur pretty evenly over the whole surface.

Witness: The object of that experiment was not to reduce the sulphur further—that was not the letter to which mine was an answer, but I suppose that Mr. Clark represented that the lime came out in an inconveniently wet condition, and my suggestion was to sacrifice one of the purifiers to some extent, so far as its service for purifying gas was concerned, by putting upon it layers of quick lime, which would serve to dry the gas passing through it, so as to cause a less deposition of moisture in the layers above.

Mr. Round: In point of fact, the suggestion referred to in this letter did not apply to the particular matter now under the consideration of the committee. It was no question whether it should be 20 or 25 grains?

Witness: Not at all. I may say that I have had a great deal of correspondence at many times with the managers of these works, and I have always taken the liberty, when I have been writing, to make any suggestions which it has occurred to me might be of service to them.

Mr. Michael: Did the engineer carry out your suggestion?

Witness: My recollection is that when I saw him he offered to do so, but I believe he was no longer finding the same difficulty. Some change had been made, I think, in the condensers, so that the lime no longer came out as wet as it had come out before, and, therefore, the object for which I made the suggestion no longer needed to be attained.

Mr. Round said he had exhausted the case of Shoreditch, and proposed to go to the Pimlico complaint, with reference to which the following letter had been addressed to the Board of Trade, dated Jan. 4, 1877. [See Journal, April 10, 1877, page 541, No. 4.] In this letter you find no fault with the process as far as the purifier is concerned, but what you do find fault with is the way they deal with it afterwards, in getting it into the barges?

Witness: Yes, the nuisance being not in the purifying process, but in removing the lime from the purifying-box, and discharging it from carts into barges, lying at the river quay. It was unprotected as it fell from the carts into the barges, and on windy days it would be blown about and carried for a distance. I think the arrangements in use at the Fulham works might with advantage have been adopted.

I see you speak approvingly of arrangements at Fulham, and suggest that if they were carried out at Pimlico, the cause of nuisance would not exist?—I do not mention that as my own knowledge, but it has been mentioned by a witness, that the lime is now thrown through a shoot into the barge, which, I think, is a very ingenious and excellent method.

Mr. Round: Bromley comes next. On the 11th of January last you wrote to Mr. Phillips the following letter. [See Journal, April 10, 1877, page 541, No. 5.] I rather gather from that, that the cause of the nuisance was similar to what it had been at Pimlico—viz., getting the lime away. You say in this letter, "We found that the refuse lime was emptied by manual labour into open trucks." That was very much what you found before, I think?

Witness: No, it was not quite the same. In the case of the Pimlico works, the purifiers are under cover, and very well sheltered from the wind, so that the lime does not get blown about when it comes out in a dusty state during the operation of emptying the purifiers. At Bromley the purifiers are not so protected, and when lime is dusty, no doubt it is blown out, and may be carried to a very considerable distance.

Can you offer any good reason why they should not be covered in both cases? Do you think it is right that they should be covered?—I think the principal reason is the expense. It is an additional expense to erect sheds over the purifiers. I know of no other reason.

At all events, you think it is desirable that it should be done?—That, I believe, would be one mode of diminishing the risk of nuisance.

Mr. Round: That brings me to Fulham. Two days afterwards, you wrote a letter dated the 13th of January, to Messrs. Leigh and Pemberton, the solicitors for the Chelsea Vestry. [See Journal, Jan 30, 1877, page 159.] It appears your attention was drawn to certain cases, and you suggested a remedy. The company adopted that remedy, and since then you have thrice visited the works, and believe that if that mode of working is carefully adhered to, no further nuisance will be occasioned. Has there been brought under your notice any instance of complaint, upon the ground of nuisance, since that date at those works?

Witness: I have not heard anything about it since. I might say that on these occasions I spent several hours in the works, and walked round and round, and stayed for a long time to leeward of the purifiers that were being emptied, so as to form the best observations I could of the amount of effluvium escaping from the lime, and, on those occasions, I have satisfied myself that when those precautions were being taken, even in the immediate neighbourhood of the purifiers, there was nothing offensive.

The Committee: Seeing the evidence we have had to-day from Lord Charles Thynne, of his having experienced a nuisance up to the present time very badly, your explanation would be that they have discontinued the precaution?

Witness: Or that the nuisance was due to some cause other than lime purification. I am strongly of opinion that gas-works are bad neighbours apart from lime purification.

Mr. Round said he had exhausted the matter as far as he thought necessary with regard to those particular cases. With regard to the general question, he would begin with a letter dated the 11th of December, which the Board of Trade addressed to the Referees, and which was as follows. [See Journal, April 10, 1877, page 540, No. 1.] That was an important letter, because the Board of Trade had thrown it upon the Referees to report to them whether the company could restrict its impurity to the amount required without creating a nuisance.

Mr. Michael: Now we have come to the general question, would you have any objection, in order to shorten the matter, to go back to the letter of the 11th of November, 1876, written by Mr. Phillips to Mr. Vernon Harcourt?

Mr. Round said he had not read the letter, because there was a request at the end to treat it as a private communication; but the witness stating he had no objection to its being made public, it was read, and was as follows:—

I trust you will pardon my troubling you unofficially on the subject of the lime purification, your determination as to which is the subject of much anxiety to the directors. I am privately informed that the Shoreditch and the Fulham parish authorities are resolved to indict us if the annoyance to which they were recently subjected, and which our engineers say they cannot prevent is repeated. The directors feel that they would place themselves in the wrong were they to disregard your instructions, but they are seriously contemplating an application to Parliament for a Bill of Indemnity against the consequences, and I yesterday received instructions to prepare a notice for such a Bill. I earnestly trust that between this and next Friday you and your colleagues may have seen your way to a definite answer to my application for a 40-grain maximum, and that it may be such as to relieve us from all the great trouble and cost of another parliamentary fight. Do me the favour to consider this a private communication.

(To witness:) You did answer that letter, I think? Do you recollect telling them that you could not accede to this application for a 40-grain maximum?

Mr. Michael: I do not think Mr. Vernon Harcourt did that. He sent a letter on the 11th of November, signed by himself and Dr. Pole, which seems to be the answer.

Witness: I do not remember whether I sent any other.

Mr. Round: We will take it as a fact that you received that application from the company.

Witness: I should think I sent Mr. Phillips an answer.

Mr. Round: Here is your answer, apparently written on the same day. This is the letter written by you to Mr. Phillips:—

As a strong opinion has been expressed to us by yourself and Mr. Evans that the sense of the public is changed with regard to the sulphur impurity in the London gas, and that they no longer care to have the maximum kept low, we think it right to send, for your and Mr. Evans's consideration, a copy of a memorial dated the 4th of November, which has been presented by the Corporation of London to the Board of Trade, and forwarded by the Board of Trade to us.

Mr. Michael: Those letters crossed—that is not the answer. You did write on the same day, but your absolute answer was written from Oxford on the 13th; and signed by Dr. Pole and yourself?

Witness: Probably.

Mr. Round said the memorial mentioned was sent to the Referees by the Corporation of London, expressing great anxiety that they should adhere to what they had already prescribed; but he did not know that it was necessary for him to read it. It was a fact that pressure was put upon the Referees.

The Chairman: Read that part which gives the grounds of objection, whatever they may be.

Mr. Round said the memorial was signed by the town-clerk, and was as follows:—

The Gas and Water Committee of the Corporation of London have received a notification from the Gas Referees as to the amount of sulphur impurity, other than sulphuretted hydrogen, to be allowed in 100 cubic feet of gas, and raising the maximum from 15 and 20 grains for the winter half year 1876-7. The 43rd section of The Gaslight and Coke Company's Act, 1876, provides "that if on any day the gas supplied by the company is of less purity than it ought to be under the Act, the average of all the testings under the Act on the preceding and on the following day shall be deemed to represent the purity on that day," and the committee therefore think that, considering the results of the testings during the last year, and the taking of the average for testing upon three days, in case of excess of sulphur, instead of the testing of one day, it is very undesirable and unnecessary that the maximum for sulphur should have been increased even during the winter months. I have therefore, been directed to request you to bring this matter under the notice of the Board of Trade, in order that the attention of the Gas Referees may be called thereto.

It appeared that the Referees had increased the maximum of sulphur, and had allowed 25 grains in the winter, and the corporation said they thought it very undesirable and unnecessary that the maximum for sulphur should have been increased during the winter months; therefore, it was putting pressure upon the Referees to say: "Do not by any means accede to the application made by the company."

Mr. Michael: I now want the letter dated Nov. 13, and sent from Oxford.

Mr. Round: This is it:—

I have been once to the Shoreditch works since I saw you, and am going again next Thursday. I hope then that my colleagues and I will be able to witness the operation of the opening of a purifier from the beginning, and to judge, to the best of my ability, whether it is productive of nuisance, and whether it is managed as well as possible. I am sorry to hear that at Fulham, also, you have been threatened with an indictment for nuisance. I have often visited those works, and have thought that, though purification was carried on under great difficulties, owing to the very small size of the purifiers, the management of the refuse material was satisfactory.

Mr. H. Clark spoke to me of his desire to adopt a process of Hills, which is in use at the South Metropolitan works, by which gas is purified from carbonic acid, and sulphuretted hydrogen by washing with ammonia obtained from gas liquor. The process is excellent in principle, and I hear that it answers well. Either this process, or that which Mr. Patterson claims, of using a distinct set of lime purifiers to stop carbonic acid, would effect the important object of reducing the quantity of foul lime necessary to keep down the sulphur in gas to small proportions. I believe the quantity of lime which is produced on the system Mr. Clark now follows is eight or ten times as great as is required for reducing the sulphur. If the heating process which was the subject of my experiment at Horseferry Road were carried out, the production of foul lime would be dispensed with altogether.

Personally I look upon the process of lime purification as commonly conducted as very unsatisfactory. It is difficult to conduct it without causing nuisance. The refuse material seems of little or no value, and it must become continually harder to get rid of it. Better processes have been suggested, and I think that gas engineers ought to be able to bring some better process into use. Certainly the conclusion which you urge, that the attempt to keep the sulphur down to a low point should be given up altogether, is one which those who have taken the question up on the part of the consumers are not likely to acquiesce in.

Mr. Michael: Now we come to the letter of the 5th of March, 1877.

Mr. Round read the letter, as follows. [See Journal, April 10, 1877, page 540, No. 2.] (To witness): I see that you attach considerable importance to the fact that at each of the works you have to deal with a different engineer, and you suggest that if there was one chief engineer who would prescribe what was to be done at all the different works, the business would be much facilitated in this matter?

Witness: We found that the same problem, which is the removal of this foul lime without the creation of a nuisance, was treated differently at different works; and we thought that at some works one part of the process was well managed, and at other works another part, and in some cases scarcely any precautions we considered were taken; and we thought that if the precautions which were used for the different parts of the operation at the different works were combined and generally applied, the nuisance would be avoided.

Friday, May 11.

Mr. *Harcourt* recalled.

Mr. Pope said his learned friend had asked him, though he was on the other side, to read some letters which it was desirable should be before the committee. The first was dated Jan. 16, 1877, and was from Mr. Phillips to the Gas Referees. [See Journal, April 10, 1877, page 541, No. 7.] The reply to that was on the 23rd of January. [See Journal, April 10, 1877, page 541, No. 8.] That letter was signed by the Gas Referees. The next was dated March 23, 1877, and was from Mr. Phillips to the Referees:—

The directors of this company met specially to-day to receive from the deputation of their number who waited upon you on Monday last, the 19th inst., a report of their

proceedings, and they hoped also to be favoured with your reply to the proposition then submitted, for such an exercise of your statutory powers as could admit of the avoidance of a most costly parliamentary inquiry. They are disappointed at having as yet received no answer from you, and I am instructed to request that any communication you may be pleased now to make to them on the subject may be in my hands prior to Thursday next, the 29th inst., on which day they will hold another special meeting to determine the course of action which they will adopt on the re-assembling of Parliament after the Easter recess.

To that the Referees replied on March 26, 1877:—

Dear Sir,—We are surprised to learn from your letter of the 23rd inst. that your directors expected from us a letter in reply to the conversation which passed when your chairman, deputy-chairman, Mr. Evans, and yourself, were good enough to come here last Monday. We are unable to send a reply, for the reason that no definite proposal was laid before us. Mr. Richards spoke of a desire to bring about some compromise, and Mr. Evans named 30 and 35 grains of sulphur per 100 cubic feet of gas as maxima with which the company might be content. Mr. Browne was of opinion that no maximum lower than 40 grains would effect what he desired, and you referred to a former request for that maximum, and appeared to share Mr. Browne's opinion.

Our letter to the Board of Trade in reply to the question, "Whether, in our opinion, the maximum amount as at present fixed of sulphur impurity with which gas supplied by the company shall be allowed to be charged, can be maintained without causing a nuisance," was read, not having been seen before by your directors, and you stated more than once that what you thought best was that your deputation should retire and consider that letter. The letter does, in effect, contain our answer; but if you have any further proposal to make to us, and will place it before us in a definite form, we will consider it at once and send you a definite reply.

We desire to add that we sincerely regret the expense to which your company may be put in endeavouring to free itself from the existing regulations respecting the purification of gas from sulphur. But we must remark, first, that we have not altered the standard prescribed by us since March, 1875, or that we are not responsible for the need of amending your Act of 1876; and, secondly, that we should be altogether exceeding our proper executive functions if we were in effect to annul these sections of your Act which you have now proposed to Parliament to cancel by fixing a maximum of sulphur impurity so high as to be inoperative.

That was signed by Mr. Vernon Harcourt and Professor Tyndall. The reply was dated the 26th of March, and was from the secretary of the company to the Gas Referees:—

I am instructed by the directors to acknowledge the receipt of your letter of the 26th inst. They regret that the proposition submitted to you at their interview was not made so clear to you as they thought it had been. The proposal made, and to which they looked forward for an answer, was that you should exercise the power vested in you, and extend the maximum of sulphur to 40 grains. Mr. Evans, it is true, did mention that he, in his experience, thought that possibly we might be safe from penalties with a 35-grain maximum, and that even at 30 grains it would be worth while to make the experiment. But the proposal to which the directors hoped to have an answer was, that you should extend the limit to 40 grains, and the result of the interview was that they anticipated that you would either accede to that maximum, or propose to extend the limit to 35 grains positively, or that you would suggest a temporary maximum of 30 grains by way of experiment.

Then on the 4th of April came a letter signed by Mr. Vernon Harcourt and Professor Tyndall:—

In reply to your letter of the 29th ult. we regret to have to state that we do not think ourselves justified in prescribing for the summer half year, upon which we have just entered, a higher maximum of sulphur, with which gas supplied by the company shall be allowed to be charged, than has been in force during the corresponding period of the two previous years.

That obviously closed that part of the correspondence, and then came the letter of the 7th of April from Mr. Phillips to the Secretary of the Board of Trade. [See JOURNAL, April 10, 1877, page 541.]

Witness: We did not attempt to write a reply to that document; but there was one point in it which we thought might need explanation, and we endeavoured to explain it.

The CHAIRMAN: I should say that last letter was not a judicious way of asking a favour of the Referees.

Mr. RICHARDS: You will remember, sir, the letter to which it was a reply.

Mr. POPE read the explanatory letter from the Referees to the Secretary of the Board of Trade, which was dated April 20, 1877. [See JOURNAL, May 1, 1877, page 666.] That letter was signed by Mr. Vernon Harcourt and Professor Tyndall, and the following, dated May 5, 1877, was subsequently written to the JOURNAL OF GAS LIGHTING by Dr. Pole. [See JOURNAL, May 8, 1877, page 699.]

By Mr. ROUND: We are all agreed that oxide of iron will not produce the degree of purity which is attainable and ought to be attained. It is also agreed that by lime a greater perfection can be obtained. In fact, in the present state of science, it is the only known means in use. That being so, the next question is how the foul lime is to be disposed of.

Mr. ROUND: Upon that, I understand that Mr. Evans says the ventilation of the foul lime is not new to him; that he adopted it at the Berlin works, I think, 38 years since; and that it would probably entirely get rid of the nuisance from the foul lime.

Witness: That appears to me to be an important statement, coming as it does from Mr. Evans, the former engineer, and now one of the directors of the company.

By the CHAIRMAN: I do not know that any process for removing sulphur compounds out of gas, except the ordinary lime process of which we have heard, has been successfully brought into use.

Mr. ROUND: I think that is admitted on both sides.

Mr. MICHAEL: That is a part of our case, certainly.

The COMMITTEE: You contemplate other methods; you say that other methods have been suggested?

Witness: That is a matter which rests with the gas companies to bring into use. There are others which, I believe, might succeed.

Mr. ROUND: What is the particular method which you think might be adopted?

Mr. POPE: I know what it is now—that is, what is in operation at Fulham, because the witness speaks of the overheating during that process, and the consequent generation of stench by naphthaline.

Mr. ROUND: That is the practice at Fulham. It seems that you and Mr. Evans are at one as to the efficacy of the system at Fulham?

Witness: I wish to say absolutely that I quite agree with the views which Mr. Evans holds as to this process, and I share his belief in its efficacy. I have seen the system in operation at the Fulham works, and I believe that its introduction is a most material contribution to the means in use for getting rid of the foul lime without creating a nuisance.

By the COMMITTEE: The peculiar system which I say is an improvement, as worked at Fulham, consists in drawing the air downwards through the lime before it is removed from the purifiers; and the advantages gained by it are—first, that the foul gas, as it is called—the crude gas with which the purifier is charged—is drawn out of the purifier by that means. Then the air which passes in carries away also the sulphuretted hydrogen dissolved in the water when the lime is damp, and by the oxidation of the lime which goes on to some extent, the material is rendered less offensive than it is when removed directly. I do not know any reason why that plan should not be adopted in the other works of the company. My opinion is that it ought to be adopted everywhere.

Examination resumed: The system adopted at Fulham is in use at some of the other works, but I can hardly say which; it has only been brought in quite recently.

Mr. ROUND: Do you know what processes there are, other than this, that are in use at the other works?

Witness: Some evidence was given recently upon that point by Dr. Frankland. There is the process which is pointed at in the letter of Mr. Phillips, which was read to the committee—the process that was tried at my suggestion at the Horseferry Road station of the company. It is impossible to say, until the process is actually in successful use, that it can be used successfully; and the committee well understand the difficulty which there is in this matter. We believe that, if the company would do their best with the object of reducing the amount of sulphur in the gas, they might develop other processes besides the one of purification by lime; but we cannot say positively, because, from the nature of the case, the matter is wholly in the hands of the company. A considerable sum, though less than that named in Mr. Phillips's letter, was expended by the company on a trial of the process which I recommended. Dr. William Siemens devised the apparatus which was employed, and I was responsible for the chemical part of it. That process consisted in bringing the gas, already purified from sulphuretted hydrogen, into contact with heated surfaces. I had ascertained, and others had observed before me, that the effect of this was to convert the bisulphide of carbon in the gas, which cannot be removed by any agent except the sulphide of calcium, into sulphuretted hydrogen, which is removable by oxide of iron. I had found also, by many experiments, that this could be effected without injury to the illuminating power of the gas. What remained was rather an engineering than a chemical question. To accomplish this on a large scale, and to construct an apparatus by which a large volume of gas could then be treated, Dr. Siemens arranged an apparatus, as far as I can form a judgment, very ingeniously contrived for this purpose, and that apparatus was in use for some months. As commonly happens in experimental works, the apparatus was not perfect; in particular, the plates which should have held in the gas which was generated cracked, and a large quantity of it escaped. The burning gas passed through the tubes of the apparatus, by means of which the heat was applied to the remainder of the gas; the temperature became unmanageable; the materials with which the heating apparatus was charged became coated with a deposit of carbon from the gas, and their purifying effect was thus impaired. For some time (on two occasions, for ten days or a fortnight together, a volume varying between 10,000 and 20,000 cubic feet per hour was purified by the apparatus; but the leaks increased, and went, as Mr. Phillips's letter says, from bad to worse, and the experiment was ultimately terminated, not, I consider, because the process failed, but because of the accident that had happened to the apparatus. The apparatus was not set up in order continuously to purify the gas that was being manufactured; it was only an experiment, and aimed at the discovery of practically purifying gas without injury to its illuminating power, and that, I believe, the experiment did demonstrate. I have since continued laboratory experiments of the same kind, and I have gained further knowledge upon the subject. My belief is, that if the company were willing to make a trial of this process, it would be practicable to overcome the engineering difficulty, but more than I have done in the matter I cannot do; it must rest with the company to try it or not. I tried every experiment myself during many years; and these large experiments were made at the expense of the company, at the Horseferry Road station, during the autumn of 1874 and the spring of 1875.

Mr. ROUND: Having shown certain good results, do you wish to convey to the committee that the company ought to have tried the experiment on a larger scale, and to have continued it?

Witness: I should be glad if they were willing to do so, as I think it offers them an alternative to the use of lime.

By the COMMITTEE: The mechanical nature of the arrangement consisted in a regenerative furnace, in which the regenerative principle was applied by causing heated gas to pass down through a chequer work of pebbles and brick, to which it gave up its heat before leaving the apparatus, and then by means of a valve reversing the current of gas entering the apparatus, the gas passed through the same brick chequer work, took up the heat given out by the former portion of gas, and so, by reversing the valve, each portion of gas was heated without the heat being carried out of the apparatus, and undoubtedly with a very great economy of heat. The quantity of fuel employed in working the apparatus was insignificant.

Mr. ROUND: From all the observations that you have been able to make, and the experience which you have acquired during your term of office, and the frequent visits that you have paid to the works, and so on, are you satisfied that even if they adopt carefully the present mode of purifying with foul lime, it could be done without creating additional nuisance?

Witness: Personally, I feel no doubt upon the matter.

Examination resumed: I have a model made here illustrating the mode adopted at Fulham. That [pointing] represents the exhauster, which is used for pumping air through the lime after one purifier has been shut off from the rest of the purifiers, and is no longer used for the purification of gas. There are some taps on the top of the apparatus which are opened, and then the exhauster is set to work. The air carries down with it a portion of the gas, which the purifier still contains when shut off. The air is then driven through this arrangement, which is a brick trough, also having perforated sieves on which are placed layers of oxide of iron. The sulphuretted hydrogen which the crude gas contains, and which, of course, is carried off from the lime in the purifier, passes up through this oxide of iron, and there the sulphuretted hydrogen is removed, while the air in the gas, which is quite inoffensive, escapes. By the continuance of this process for some time the lime becomes comparatively inoffensive. There were one or two suggestions which I ventured to make to the superintendent of the works on visiting him and seeing this process. One was, that as far as possible the surface of the lime exposed at any one time should be reduced. One of the complaints of which the committee have heard is, that the difficulty is far greater on a large scale, because, with the large purifiers that are used, a large surface is exposed, and it seemed to me, though I am only an amateur in such matters, that this large surface might be reduced by having the arrangement here represented, by which one portion of the lime could be covered over when the lid was raised, so that when they were shovelling the lime into their bags no offensive smell would escape from the part covered with the sacking.

The COMMITTEE: Do you mean that this does not entirely purify the lime before it is removed, but that it only contributes to the purifying of it?

Witness: It only contributes to it; the air might have passed for many hours, and the lime would even then be in some degree offensive when taken out. Something depends upon the condition of the lime—how far it is damp or dry. If the lime were damp, I feel no doubt that drawing the air down to dry it takes out the sulphuretted hydrogen. I believe that two or three hours passage of air through the lime would generally make a considerable difference in the degree of offensiveness of the lime. I also suggested that this down current of air through the lime should be continued during the operation of discharging the purifier. That, I think, is important, especially when a part of the surface is covered up—it produces a distinct down draught through the substance, and makes it much less likely that any effluvium or fine particles should be blown away from

the surface. When this operation has been going on, I have made observations round about. I mounted here [pointing to the model], and stood there for some time, and observed as carefully as I was able the degree of smell which came from it; and my conviction is, that when the process, with Mr. Evans's improvements, is rigidly carried out, nothing can escape that is offensive to the neighbourhood.

The COMMITTEE: What does this represent [pointing to the model]?

Witness: I might explain this also, as it is a very important part of it. The lime, when it is dug up from the layers, is shovelled into bags, which are carried on men's backs up a plank laid at the side; then it is tilted over and falls through a trap into a waggon, which runs on a tram. As soon as the waggon is full, it is covered over and runs to another point, where a second hood is let down over it, and then, by levers which stand out at the side of each of the waggons, the bottom of it is allowed to fall out, and the lime drops, still protected, into a barge, and there it is covered over. This is an arrangement which, I believe, was contrived by Mr. Kirkham, and it appears to me to be very well designed for avoiding any nuisance in that operation.

Mr. ROUND: How far has the sulphur been removed from the lime by this process?

Witness: I should think very little sulphur is removed in the process; the effect of the action of the air upon sulphide of lime is not to remove the sulphur, but to oxidize it, and as far as it is oxidized it is inoffensive.

At all events it removes the sulphuretted hydrogen?—It does rather more than remove the sulphuretted hydrogen which hangs to damp lime; it oxidizes the lime sufficiently, converting the sulphide of calcium into sulphate of calcium, and so renders the lime less liable to give sulphuretted hydrogen off when exposed to the moisture of the carbonic acid of the air.

Examination continued: The principal defect which there seemed to be in actual working at Fulham was that there is one of the exhausters only in use, and that is in connexion with three distinct sets of purifiers, two of which are emptied simultaneously. Now, since the same pump is used to pump air downwards through each, the two being simultaneously entered, and since the rate of discharge of layer after layer will not proceed simultaneously *pari passu*, it must frequently happen that the down draught is only operating in the case of one of the two purifiers, and in that case the other is without the protection which it furnishes. I think it would be necessary that there should be a pump to each, which there would be no difficulty in having, as they are not very expensive.

Mr. POPE (in cross-examination): The words, "A practical knowledge and experience in the manufacture and supply" point to somebody who has been engaged in that manufacture and supply. Which of your number satisfies that requirement?

Witness: I think it may be taken that my colleague, Dr. Pole, has a much larger experience than I have had. At the same time, I have been occupied on practical matters connected with the manufacture and supply of gas for some seven or eight years, and though one is unwilling to claim for one's self any particular knowledge, I believe I am not without that knowledge, although I have not been actually engaged in the manufacture and supply of gas. A great part of the correspondence has been undertaken by me, and I have had special work in connexion with the purification which the Board of Trade asked me to undertake. I have visited all the stations of The Gaslight and Coke Company, with reference to the complaints of nuisance which have arisen—Haggerston, Pimlico, Bromley, and Fulham especially. The reason we made a variation in our requirements for winter and summer was because the same amount of purifying material will effect a greater purification when the volume of gas passed through it is less, and the volume of gas passed through is less in summer than in winter.

Mr. POPE: I may take it that, in your judgment, the quantity produced in relation to the purifying apparatus ought to modify the requirements of purity?

Witness: Or else the amount of purifying plant, as it is termed, should be increased. If the make of gas is to be spoken of as indefinite, the amount of lime used should be indefinite also; in other words, if it be an inevitable nuisance, it will be an increasing nuisance.

Supposing the lime process not to be used, but a return to be made to the oxide of iron process, what amount of sulphur impurity would be left, or should you expect, in gas, supposing the oxide of iron process to be perfectly and carefully carried out?—I think it would average about 33 grains in 100 cubic feet.

Then the lime process is rendered necessary in order to get rid of 13 grains in 100 cubic feet, according to that calculation?—More than that.

No; you prescribe 20, and if there was no lime used 33 grains would be the result; the lime process is therefore rendered necessary to get rid of those 13 grains?—I spoke, not of the maximum, but of the average; you are comparing the maximum with the average. I think what the company have named—40 grains—is the right maximum.

We may take it that it is to get rid of from 15 to 20 grains, according as it is winter or summer, that the lime process becomes necessary?—Yes.

Do you still think that "much is to be said in favour of the view that the presence in gas of the small amount which lime purification removes is of no great consequence to the consumer"?—I certainly think so. I have heard a great deal said upon that subject within the last two weeks.

I do not want to commit you to an absolute statement; but, taking the whole matter—the information you gain from what you have heard and read, and what other chemists are doing and saying, and so on—what do you say now as to the inclination of your opinion that it is of no great consequence to the consumer to get rid of the small amount of sulphur which lime purification removes?—I would say of no great consequence.

It comes, therefore, does it not, to be a question whether you should relax your requisition of 20 grains, supposing the carrying out of the lime purification, or some other process, creates a nuisance?—Yes; I think that unless we believe that by some means gas could be purified without the creation of a nuisance at the maxima that we have named, it would be our duty to fix a higher maximum—such as 40 grains.

You would not, I suppose, insist upon your maximum simply because hereafter some means may be discovered?—No.

It would be quite time enough to fix your maximum when it is?—Certainly.

I have read with great interest what you have done with regard to the heating process you speak of, but you would hardly say that that, at all events, should be taken into account to-day as a process of purification?—I think only as illustrating the likelihood that, besides the process actually in use, if the obligation is continued upon the gas company to purify their gas beyond the removal of sulphuretted hydrogen, other processes besides the lime process may come into use.

Cross-examination continued: We have not maintained our maximum at its present figure in order to stimulate the company. We fixed the maximum simply because we believed it was a maximum which was practical, without the infliction of injury upon the neighbourhood. When I first visited Fulham the whole arrangement for the removal of lime from the purifiers was already in operation. The other point I have named—that is to say, the covering over of a part of the lime when it was exposed, and the continuance of the down draught after the raising of the lid; and another point, which I have not mentioned yet—namely, damping the lime when it was found, on lifting the lid of the purifier, that it was in a dusty condition—those matters were adopted at my suggestion. My last visit to the Fulham works was towards the end of January.

Mr. POPE: Did you at that time carry with you any test, such, for instance, as a bit of blotting-paper in your hat, which was saturated, with a view to ascertain whether there was sulphuretted hydrogen given off, notwithstanding all these precautions?

Witness: I placed nothing in my hat, but I am very familiar with the smell of sulphuretted hydrogen, and could detect a very little at once. I do not think that the bad smell of the refuse lime is merely the smell of sulphuretted hydrogen, but I do not know what it is. It has never produced any bad effect upon myself except the dust, which is certainly unpleasant to the eyes when it is blown from the purifiers; and I have also found that the smell of the refuse lime is extremely persistent when one's clothes have been covered with this dust. I think that dust would travel half a mile on a windy day. On a wet, soft, muggy day it would not travel so far.

Mr. POPE: How do you account, if it be the dust, for the fact that everybody complains of it more at a distance in wet muggy weather than they do when the weather is windy, or the atmosphere clear?

Witness: I think what they complain of is the smell of the gas-works. I do not think most of them can distinguish between the portion of the bad smell due to refuse lime and other smells.

What is your opinion with regard to the smell of the gas-works? Is it better or worse during foggy days?—I think it is worse immediately in the neighbourhood of the purifiers, but probably the smell would not be carried so far.

I do not say there may not be a nuisance from the dust; but assume that it is proved that the nuisance is worse at a distance, under atmospheric conditions less favourable to dust travelling, would you, as a scientific man, then abandon the dust as the cause of the nuisance, and look for something else?—I think it more likely, if it were found that the nuisance at a distance was greater on still days than on windy days, that it would be due to some gaseous emanation, and less likely to be due to the dust.

You say you doubt its being sulphuretted hydrogen; what other gaseous emanations would you suggest?—Smells which have never been analyzed; I think I may say that positively. It is not known what substances produce the impressions of smell which you receive in the neighbourhood of gas-works, but there can be no doubt that they are very various.

Have you any experience with regard to this process of ventilating, as you call it—drawing air through a chamber for the purpose of purifying lime?—Yes; I have seen it done occasionally.

What special danger attends the use of that process?—The heating of the material, which I believe has been found to reach such a point that the sulphur in the mixture of the gas and air might inflame and explode.

Explosion is the danger. Do you know that, in point of fact, explosion is found to result where the process has been carried on to an undue extent?—I have heard of explosion resulting, and I have seen an arrangement at Fulham for the purpose of avoiding that. I might add, however, that I think it should not be difficult, as the exhauster gives a perfect power of controlling the current of air, so to regulate it as to prevent the temperature reaching this point.

Would there be a tendency in this ventilating process to carry over into the oxide of iron other sulphur compounds besides sulphuretted hydrogen?—I have made the best experiment it is possible to make. I have stood by the side of the brick trough holding the oxide of iron when the ventilating process was in action, and I have observed that on the surface of the oxide no smell, or next to none, was perceptible.

Cross-examination continued: In one of my letters I suggested that the purifiers might be under a shed or cover, and that that would reduce the nuisance, and I believe the plan is adopted at Pimlico. I believe the source of the nuisance is not the purifiers in the shed, but the emptying of the lime, as I saw it tipped from the carts in the Grosvenor Road into the barge. All the smell that lime can possibly give off arose when the contents of the carts were tumbled down a distance of between 20 and 30 feet. The lime was shot out in a solid stream from the tail of the cart into the barge.

Mr. POPE: The main difference between us comes to this—you rather attribute the nuisance to this dust than the sulphuretted hydrogen?

Witness: I think a great deal depends upon the condition of the lime when the purifier is being emptied. Sometimes it is extremely wet; and in that case, unless the ventilating process has been in use, the water in which the lime is damped will contain a considerable quantity of sulphuretted hydrogen; and I believe also that the lime, when damped, will give up the sulphuretted hydrogen more readily to the air than when it is dry. Of course, also, when it is damped, no dust will be blown from it; therefore the cause of the nuisance may vary according as the lime is damp or dry, and I believe it does so vary.

You doubt whether it is sulphuretted hydrogen at all?—No, I have not thought that; but I do not admit that if the lime is damped the smell coming from it must be sulphuretted hydrogen. I have said that the smell is of a complex character.

It is not merely a question of smell. You, as a chemist, would be able to recognize sulphuretted hydrogen, not only by the smell, but by the physical results?—As a chemist, I might recognize it by the chemical results.

There are well-known physical symptoms, the result of inhaling sulphuretted hydrogen, are there not?—I have never suffered from it. I know the smell very well; but a smell may be disagreeable without your suffering in health.

I was speaking of noxious, unwholesome, and unhealthy?—I have never heard of any evidence in the sense you use the word "noxious"—that is to say, injury resulting from the exposure of refuse lime at gas-works. If the air contained a sufficient portion of sulphuretted hydrogen, no doubt it would be poisonous. I have never seen a case of injury by sulphuretted hydrogen.

By the COMMITTEE: Between two and three years before I was appointed a Referee I was engaged in experiments at the Oxford Gas-Works, and I spent a great deal of time upon those works, during which time I became familiar with all the ordinary operations of gas manufacture. I was making those experiments on my own account. Some questions had been suggested to me by a friend of mine, who is the son of the manager of the Cheltenham Gas-Works, and becoming interested in the subject, I engaged in those experiments. I suppose, during a period of six months, I was there about every other day. I was engaged partly at the gas-works and partly also on similar experiments upon a smaller scale in my own laboratory. During that period the chief part of the leisure which I had for scientific work was devoted to experiments in connexion with gas purification, or to observations of the illuminating power of gas; and I have also undertaken experiments on a larger scale at gas-works. My opinion has always been that the small amount of sulphur which the lime purification removes is of no great consequence, but I do not consider that is a point upon which officially we had to form any opinion as Gas Referees. I

think the smell of sulphurous acid is observable in a room which is not well ventilated, and which is caused by the gas, when it contains rather a large proportion of sulphur. The gas which is supplied at Oxford is not so well purified as London gas now is, and I have observed, when there has been no fire burning, and we have been sitting three or four hours in the room, that I could recognize the smell of sulphurous acid, which, as a chemist, I am very well familiar with; and I think also it is likely —though in my opinion I am not clear—that it has been proved that injury to articles of furniture may arise from the deposit of sulphuric acid upon them, but I do not think there is any positive evidence upon that point. I do not think it likely that it produces any injury to health or life in any way. I have heard it stated that in the case of delicate persons it does so, and that may be the case. Wherever ammoniacal liquor is exposed, there is a smell of sulphuretted hydrogen much more distinct than that which is produced from refuse lime. There is always a little exposure of it, as it runs from the condenser into the pipes by which it is conveyed to the liquor well, and there is always a liability to some exposure of it in storeage and removal. I heard the evidence given by Lord Charles Thynne, but I do not remember whether he was able to state positively that the smell he observed was the smell of sulphuretted hydrogen. There certainly is some escape of sulphuretted hydrogen from the other processes in the neighbourhood of the well which holds the ammoniacal liquor, but it would be, I think, quite as easy to observe the presence of the sulphuretted hydrogen in the neighbourhood of an open purifier, and also in the neighbourhood of an oxide purifier when the oxide is damp; the smell of sulphuretted hydrogen at first is sometimes very perceptible. At the Fulham works, on the occasion of one of my visits, I observed a very bad smell, and I asked the superintendent, who was with me, about it, and found out that it was due, not to lime purification, but to a purifier containing oxide of iron, which had recently been opened, and had been partly emptied. The men had gone to breakfast, the material had heated in the purifier, and a worse smell proceeded from it than I have ever observed from any lime purifier.

The COMMITTEE: You said that, under the plan of purifying by oxide of iron, about 40 grains would be the sulphur impurity?

Witness: Not on the average, but the maximum. The present reduction from 40 to 20 grains depends entirely on the use of the lime process.

Supposing the lime process had not been discovered, if that were put out of consideration altogether, the process of purifying by passing over heated substances is not of so well ascertained a character that you could reduce it from 40 grains to any other standard?—I think it should be understood what the difficulty is. The introduction of this rests with the gas company. They would prefer that they should be freed altogether from the obligation rather than that they should have the chance of risk and failure that there is in the introduction of a new process.

No doubt, supposing it rests with you to determine the maximum, and that you had settled in your own mind that 40 grains was the maximum with the oxide of iron process. The lime process I put out of consideration altogether, but there is this process of passing gas in contact with heated surfaces, which would admit of further purification if it were a practicable plan. Do you consider that it is so far a practicable plan that you could at the present moment reduce, or that you would be justified in reducing, the maximum from 40 grains to any other figure?—No; I think if it were not for the existence of the lime process, and the possibility of conducting the lime process without a nuisance, that we should be obliged to prescribe a maximum of 40 grains.

Mr. MICHAEL: I should like to be allowed to state that we are exactly on all fours with Mr. Vernon Harcourt as to that, and I say so with a view of saving any expenditure of time upon the points on which we are in accord.

The COMMITTEE: It was entirely in the interest of your side that the question was put.

Mr. MICHAEL: It has entirely cleared up the matter, because that is exactly the view which we take. I am obliged to Mr. Vernon Harcourt for having so exactly stated the position, and in it we are entirely in accord with him.

By the COMMITTEE: I heard the evidence of Professor Church, Professor Barff, and other witnesses in the last case, and I feel no doubt that there is sulphuric acid produced; but my own belief is that it is only a small portion of the sulphur which passes at all into the air which is converted into sulphuric acid in the air of a room; and I thought the experiments which have been instituted by Dr. Odling and Mr. Russell, as well as the calculations upon the subject submitted by Dr. Odling, were very instructive. I attribute the destruction of pictures and of bookbinding more to heat and dryness than to any sulphur compound of the gas. As to the deposit of sulphate of copper, that undoubtedly occurs. I have myself collected from the surface of a brass tube, which was placed over a gas-burner with the intention of carrying off some of the products of combustion, a considerable quantity—half an ounce or more—of what I afterwards analyzed and found to be crystals of hydrated sulphate of copper. That was undoubtedly produced from the fact of the sulphur impurity. I think there is really no difference of scientific opinion upon the point that some sulphuric acid is produced by the combustion of gas containing sulphur. I quite agree in the opinion that, if the process of purification by lime for these sulphur compounds can be conducted without a disagreeable smell being produced, it would be worth while to continue that process. It appears to me to be purely a question of cost. I believe that the difference in the cost of purification down to the limit of from 20 to 15 grains of sulphur, and down to a limit of 40 grains, would not exceed something like 2d. in 1000 cubic feet, and my opinion as to the likelihood of some injury to books, furniture, pictures, and curtains, resulting from the deposition of this minute quantity of sulphuric acid upon them, is sufficient to make me think the difference of price worth incurring. I feel for myself, if I may state it in that way, that if I had the alternative of burning in my house either of the two samples of gas—either the one with the maximum of 40, or the one with the maximum of 20 grains—and I had to pay the 2d. more for the purer gas, I should choose the purer gas, and pay the extra 2d.

By Mr. O'HARA: I am aware of the fact that in 1876 the Chartered Gas Company came to Parliament for a new Act, and I understand that that Act of Parliament was the result of a negotiation between the company, the Board of Trade, the Metropolitan Board of Works, and the Corporation?

Mr. O'HARA: Was there any greater difficulty in the summer of 1875, and in the summer half of 1876, than there is now? or is there any greater difficulty in the summer half of 1877 than there was in the summer half years of 1875 and 1876, to comply with your prescribed maximum?

Witness: Only such as would arise from the continual increase in the amount of gas supplied. I am not aware of any special circumstances at present which make it more difficult for them to comply with our prescribed maximum than there was in those two summer half years, except the difficulty which has been pointed out in the disposal of large quantities of refuse lime; and, if the area on which it can be placed is small, that difficulty must also increase continually. That would be a question of situation, also of expense. When The Gaslight and Coke Company's Bill of 1876 was passing through Parliament, I was, as a Referee, consulted about the change in the mode of inflicting the penalties. The gas company represented that it was a hardship that they should be liable to a penalty for the impurities of one day. I advised the Board of Trade that it would be fair to substitute an average for the result of one single day, and I believe I suggested to Mr. Phillips the actual wording of the clause. At that time, when the Bill was settling the capital and the initial price, and all sorts of matters connected with the company's affairs, no representation was made about the impurity question.

Mr. CRIPPS: You say that this is really a question of expense, so that, in fact, to relax the conditions, which my learned friends by their Bill are endeavouring to do, would be practically increasing to the consumer the initial price of gas? Do you follow me?

Witness: I follow you; it would make a difference of that kind.

In fact, you say it costs about 2d. per 1000 feet to purify the gas according to your rules?—I think the difference would be effected for that sum.

Putting that as the maximum; then we see the price of gas was fixed at 3s. 9d. per 1000 cubic feet, and at that time Parliament left you to prescribe the degree of purity or the maximum of impurity which was to be found in the gas?—Yes.

Supposing this 3s. 9d. to be the price of gas, purified according to your rule, that would be putting the price to the consumer of unpurified gas at 3s. 7d.?—If I am right in the figure, it does not represent any calculations of mine, but it is the difference that I have heard stated.

If you call the price settled by the Act of last year 3s. 9d., under this Bill 3s. 9d., *minus x*, ought to be the price if the conditions of impurity were relaxed?—That seems fair.

In 1876 the degree of purity that you prescribed was identical to that which you are prescribing at the present moment?—Yes; we have made no change for two years.

Had the gas company had the experience of 1875 and 1876 when they got their last Act of Parliament?—That is so.

May I take your evidence generally to be this, that the process required to be carried out by the company can be carried on without producing a nuisance?—I believe that to be so.

You believe that the purifying material, after it is used, can be effectually purified?—It gradually changes into an innocent substance by standing.

Cross-examination resumed: I have heard no evidence as to the particular explosion that has been referred to, but I can easily understand how an explosion would arise if air is drawn through so rapidly as to produce a rise in temperature up to the inflaming point of sulphur, which is not very high. I do not think the question of purification has been merely a matter of cost. I have no doubt that a great deal of annoyance has been caused to managers of gas-works, both by the difficulties which there undoubtedly are in the operation as it has been conducted—I think in many cases without the precautions which might be used—and, no doubt, the complaints of nuisance, so far as they are due to this cause, have been another source of annoyance. I do not myself (but I am only giving an opinion) consider that to gas managers generally it is simply a question of cost.

Mr. O'HARA: That is not quite an answer to my question. Supposing they had understood that, provided they were simply remunerated for any extra expense to which they were put in arriving at this degree of purity, so far it would be a question of expense?

Witness: Yes.

But being secured from loss and paid what they wanted, do you really think that you would have heard of all these difficulties?—I cannot say certainly.

Do you not think that the extra price would have removed a great many of those difficulties?—I do not know that I can form a judgment of what their motives would have been.

By the COMMITTEE: I have often considered this matter with my colleagues, and I believe they agree with my views.

Dr. *William Pole*, examined by Mr. ROUND.

Mr. Vernon Harcourt hardly correctly answered when he said I was appointed a Referee at the same time as himself, because I was appointed two years earlier—when Mr. Evans retired. At that time Mr. Evans's colleagues remained with me, and we formed the board till 1872, when they were not reappointed, and Mr. Harcourt and Professor Tyndall were appointed in their places, so that I am two years older in the appointment. I have been in the room the whole time, and have heard Mr. Vernon Harcourt's evidence, and I concur with what he has said. We have acted together all through, and we have been entirely agreed in everything that has been done.

The COMMITTEE: Is there anything you wish to add to what he has said?

Witness: No; except that there was a good deal of correspondence, and a great many events occurred between the time when we first fixed the maximum and the time when he began to give the historical account. The first act of our predecessors, in August, 1872, was to give notice of their intention to fix a maximum of 15 grains for Bow and Beckton, where lime could be freely used, but for other works they postponed the maximum. Our first step in the matter was to confer with the engineers of the gas companies. We knew there was a strong feeling that the sulphur must be reduced, because it had been a matter constantly discussed between our predecessors and the authorities of the public and the gas companies. It was a matter forced very strongly upon our attention, and since our predecessors had resolved to fix a maximum which had never been done before, it was, of course, a matter of serious consideration for us whether we should carry out that step. Accordingly, on the 5th of September, 1872, five days after our duties began, Mr. Evans and Mr. Harris, the then engineers of the Chartered Company, attended, at our request, at our office, to discuss the subject, and after a long and full discussion a decision was come to, which I will read an extract from the minute-book to explain:—

Mr. Evans and Mr. Harris attended, and were introduced to the Referees; the subject of the sulphur maximum was fully and lengthily discussed with them. It was agreed that the following passage should stand part of the forthcoming Instructions:—"For gas made at Beckton and Bow, where lime can be freely used for purification, the maximum amount of sulphur allowable has been fixed for the present at 20 grains per 100 cubic feet of gas; for gas made at other works no maximum has yet been fixed, and meanwhile the quantity shall simply be recorded." Mr. Evans stated that he consented to this maximum, and would use every endeavour to adhere to it; but he wished a note made to the effect that he should hope for protection in case of a disappointment. Mr. Evans wished the attention of the Referees to be called to the great expense of lime purification as compared with that effected by oxide of iron. Mr. Harris called attention to an increase of sulphur as the quantity of gas made increased.

The maximum was accordingly fixed, as has been already explained to the committee. This proposal, as far as we could ascertain, appeared to work very fairly, and the sulphur was kept well down; and I do not remember any complaints from the company that there had been difficulty. Our attention then was directed to the purity of the gas supplied from the other works. Complaints were urged upon us of the sulphur it contained; I need not read them, but we knew that the attention of the public was drawn to it, and we had very strong complaints from private parties addressed to us. We made ourselves acquainted with the experience that had been gained elsewhere as to the use of lime in various

towns, and we inquired as to certain cases where lime was used in London. At Pimlico, for example, lime had been used. I have the minute here which will show we found that to be the case:—

On the 7th of February we went to the Horseferry Road and saw Mr. Brothers, the superintendent of the station. We went in with him to the Equitable works at Lupus Street, and looked over them. About four-fifths of the gas is purified by oxide of iron only, for one-fifth of lime is used in conjunction with the oxide. The latter is much reduced in sulphur, and improved in illuminating power. We did also notice that at one gas-work in the heart of London, (Blackfriars), belonging to the Chartered Company, the sulphur had been kept very low by certain precautions, as we believed, in the management of the works. The result of our consideration was a conviction that we might safely fix a maximum for the urban works; but before doing this, we thought it right again to confer with the gas engineers most interested, and on March 13, 1873, we had an interview with Mr. Brothers, one of the superintendents.

I will read the minutes of what took place:—

Mr. Brothers attended in support of his letter of the 11th of March, remonstrating against the assumed intention of the Referees to fix a 20-grain sulphur maximum for Lupus Street station.

He stated that though he would accept this maximum for the summer months, he should not be able to do so for the winter, as under the large make of gas his purifiers had not sufficient area to allow lime to be used in sufficient quantity, for if the area was limited under a heavy make of gas, the pressure necessary to drive the gas through became too heavy, and blew the seals. The disposal of the foul lime caused inconvenience; but he did not attach so much weight to this, as it might be got over with care and proper arrangements. At present about half his gas was purified by lime (bringing sulphur to say 10 grains) the other half by oxide (say 30 grains) average 20 grains. He was quite willing to accept 20 grains for Lupus Street and Kensal Green, for the summer, on the understanding it was to be reconsidered for the winter. The Lupus Street works were never intended for dry lime; they were limited for space, and their space could not be extended. Dry lime purifiers required so much more area than oxide.

On the 21st we saw another of the officers of the Chartered works—Mr. Mann—who had the management of the works, which are now abandoned, at Blackfriars. Our minute of the 21st of March is—

Mr. Mann attended and consented to a sulphur maximum of 20 grains for the Blackfriars works.

Upon this encouragement we decided to fix the maximum of 20 grains for the urban works. But we thought it would not be right to do it at once, and we gave the companies three months notice that it would come into force on June 30, 1873. Of course we received some protests, which were to be expected. It was our unpleasant duty to put some pressure upon the companies, and it was natural they should resist it as much as they could; but our duty was to convince ourselves that we were acting only fairly. We received several protests against any maximum being fixed, principally on the ground that the works would be likely to find a difficulty in avoiding the nuisance. I have the dates of several letters, and our answers, which can be read or not, as the committee may decide. Then we considered the matter very carefully. We had an interview with the Board of Trade, and we made ourselves acquainted with the experience in other quarters. I should say that during that time we had used every endeavour to find out what was done elsewhere, and I have a great number of memoranda of what was done in different towns which we visited, showing, at any rate, that we took all the pains we could to inform ourselves. We also visited some works where experiments were being tried, because the companies, very rightly and properly, before the date came when they would be called upon to adhere to the maximum, began to use the lime, to try what would be the effect of it. The 30th of June approached, when our maximum was to come into force, and then the companies remonstrated, and took a good deal of pains to show that they were not ready—the committee will have read that. We saw the justice of their complaints, and relaxed the maximum five grains on the 30th of June, for which the companies expressed themselves very much obliged. Then came other correspondence, complaining of the nuisance at some of these places, and every complaint was investigated and answered. The letters and answers are at hand, and can be produced if desired, showing that we spared no pains to inform ourselves as fully as we could. On the 3rd of July we had a letter from the authorities of the City, on the other side, complaining in strong terms of the relaxation that we had made, and that we had not kept the maximum so low as we ought to have done. The City were constantly complaining of us, and in a letter written and sent to the Board of Trade, a very strong complaint indeed was made that we were not doing our duty, and not keeping the maximum so low as we ought to have done. They even went so far as accusing us of being unfit for our duties, because we had not pressed the companies more. Afterwards, on the 30th of June, at the urgent request of the companies, we released the maximum of five grains, and we received the following letter:—

Guildhall, E.C., July 23, 1873.

Gentlemen,—I have to inform you that the circular issued by the Gas Referees, with respect to the maximum of sulphur as proposed to be fixed by you for the winter months at gas-works other than Bow and of Beckton, has been laid before the Gas and Water Committee of the City of London, and they have directed me to state that they feel much disappointed at the change proposed, as they had been led to expect that the maximum would have been diminished at all the stations rather than increased at any; the more especially as in their opinion ample time has been given to the companies for the necessary alteration in their apparatus for purification. I am further to call attention to the great desirability of diminution in the quantity of sulphur in gas from the deleterious effects it produces, not only upon substances exposed to its influences, but also to the health of those inhabiting the rooms in which gas charged with it is burned.

I am, &c.,
JOHN B. MONCKTON, Town-Clerk.

Our answer merely stated that we had done what we thought just, and could not do more. There were then some further complaints, which were investigated and answered. There were also some complaints in 1874. On April 23, 1874, there was a very long communication from the town-clerk to the Board of Trade, complaining of our conduct generally as being too lax upon the subject of the sulphur maximum. That letter contained the following passage:—

The committee have, however, reason to believe from the reports received of the amount of the sulphur impurity, as tested at Beckton and Bow, that there is not now that care and attention bestowed upon the carrying out of the process of purification at these works, and more especially at Bow, which would obtain a much lower amount of sulphur in the gas than at present exists; and the committee cannot but think that were the maximum considerably lowered, the result would be a corresponding diminution of the daily proportion of the sulphur in the gas supplied from Bow and Beckton. As regards the other gas-works under the supervision of the Referees which supply the Metropolis, the committee consider that a sulphur maximum of 30 grains is no check at all upon the gas companies, seeing that equal results have been obtained without the adoption of any special means or process for removing the sulphur impurity. Such a maximum, therefore, appears to the committee totally at variance with the spirit and intention of the London Gas Acts, 1868 and 1869, and a failure on the part of the Gas Referees to discharge the duty entrusted to them under those Acts.

At that time Dr. Letheby was not advising the corporation upon that point, because he was the chief gas examiner, which was an independent position under the Board of Trade. The principal argument used by the corporation was that because our maximum had succeeded in giving an average very much lower than the maximum (which, of course, it would be) that was an argument why we should bring it down to that point, or near it. It was because the companies had worked very well under our maximum that we should lower it still more. I have a great many more letters, but, unless the committee wish it, I do not think I need trouble them with them. Many of them contain evidence that we had visited the works, and did not find the nuisance which was asserted. I merely mention this to show that whether we were judging rightly or wrongly, we had given all the attention we possibly could to the subject. We also made ourselves acquainted with what was done elsewhere, in order to form our opinion whether or not this was practicable, and we came to the conclusion that it was.

By the COMMITTEE: We visited Edinburgh, and found that lime was used entirely there. The works were in one of the best parts of the town, between Carlton Hill and Canongate, and I went carefully over them. I spent some days with the manager. I found that lime was used exclusively. I was living in Princes Street during the time when the wind was blowing from the works towards the hotel, and I noticed no nuisance, and there was nothing in the gas which gave me reason to suppose that it would be impossible to purify it by lime. There were no complaints from the hotel-keepers. If there had been a nuisance it would certainly have occurred at that time, because it was the most favourable time for it. The wind was blowing strongly from the gas-works towards the hotel. I noticed that at the time, and I communicated with the authorities. I think the purifiers were opened while I was there. I may say that I also went to Nottingham, and found exactly the state of things that has been given in evidence by Mr. Loam. I could not do better than refer to his evidence. I also went to Leeds. The Leeds Gas-Works are situated in a populous district and lime is used there.

By Mr. CRIPPS: I do not know the amount of sulphur impurity remaining in the gas. I also made inquiries at different times as to other towns. I was engaged myself professionally at Pontefract, a small town truly, but where gas was made for the whole population, and nothing but lime used there. They had never heard of the oxide process.

By the CHAIRMAN: I am not aware that they took any special precautions at Edinburgh. The purifiers were under cover, and the lime was put into railway trucks and sent immediately away. It was not stored. If it had been stored, the manager told me, they would have had some difficulty, but it was sent away immediately.

Cross-examined by Mr. MICHAEL: At Haggerston we discovered a nuisance, but nothing to speak of. At Pimlico there was a nuisance, decidedly. I myself did not direct the engineer at Pimlico to adopt any other measures than he was then adopting. Mr. Harcourt, as he told you, made several suggestions; but I do not think that personally I ever made any suggestion, because my view was that it was not our duty to do so. We were merely to satisfy ourselves whether the process could reasonably be carried on without a nuisance. I have never been an officer of a gas company, but I have had, as an engineer, a great deal to do with gas-works and gas manufacture, beginning from the year 1838, and continued more or less to the time when I was appointed by the Board of Trade. I told them very freely and candidly exactly what my qualifications were, and I asked them to refer to certain authorities—I mentioned the best known gas authorities in London—as to whether I might be considered a competent person to fill the post. What answers they got I do not know, but the result was that I was appointed in 1870.

By the COMMITTEE: In several cases we found there were no precautions taken at all. At Bromley, for example, the thing was worked just as if the material had been entirely innocuous and inoffensive. I am not quite sure whether or not I signified to the engineer that there was a want of proper care and precaution in carrying on the process. I think that Mr. Harcourt did; he has generally done that.

Mr. O'HARA: With proper care, do you think that the company could reasonably be required to keep their gas as pure as you prescribe?

Witness: We answer that by prescribing the maximum. It is more a question of expense than of care. I do not at present see that increased expense need be incurred, but it is possible that some expense might be.

The COMMITTEE: What Mr. O'Hara means is this. Do you agree that twopence would be saved if there was no restriction at all?

Witness: I have no knowledge about that. It is generally assumed by engineers that the total cost of purifying by lime is about a penny per 1000 cubic feet; and I know when the commissioners settled the price of gas some time ago, they allowed a penny per 1000 feet extra to the companies, on the ground that we had required them to use lime. I may say, upon the question of price, that we have been often assured by the representative of one of the largest companies in London, that the use of lime was not so expensive as was generally supposed, because it made the gas a higher illuminating power; but I have no knowledge on the subject myself.

Professor *Tyndall*, examined by Mr. ROUND.

I have listened to the evidence of Mr. Harcourt and Dr. Pole, and I entirely agree with my two colleagues as regards this question. I was very much struck by a remark that was let fall by Dr. Pole, that the nuisance was very frequently absent when we were there, for that entirely coincides with my individual experience on some occasions. I have made the remark that the nuisance appeared to me exceedingly small, and the answer of the engineer was: "This is a particularly favourable day. It is not so bad to-day as it is sometimes." I am quite within the mark in saying that that answer was given to me at least twice by different engineers. Again, I went down to Fulham, and went round the works there, and I must say I was exceedingly impressed with the great care bestowed upon this question at the Fulham works. The amount of care shown was infinitely greater than the care expended at the other works. I had the honour of being accompanied on that occasion by a person for whose opinion I have a very great esteem, and who has particularly good olfactory nerves—I walked in company with my own wife round these works. I took particular care to go to leeward, and Mr. M'Minn, the highly intelligent engineer of the works, was there. I said to him: "Why, Mr. M'Minn, we are here to leeward; the wind is blowing from the purifier towards us, and there is no nuisance here." He made the same remark as before, adding that possibly there might have been a nuisance half a mile away; that the nuisance might have got upon the air and have been wafted through the higher atmospheric regions, and might have descended at a distance; but I can truly say, as far as my observation went—and I gave the matter all due care—that I am disposed to give the gas company very great credit indeed for the care bestowed on this question at Fulham, although not at the other stations, I am bound to say. I think there is a great deal to be said for the gas company. It is a process that requires a good deal more trouble than appears, but I cannot entertain a doubt that if the company took it up with vigour, and with a determination to solve the problem, they are quite able to do it.

Cross-examined by Mr. POPE: I only visited Fulham once; but I have not the slightest recollection that two or three hours after I left there I experienced any effects as if I had inhaled sulphuretted hydrogen or anything of the kind.

Mr. POPE: Assuming that a person's experience on the spot was like your own, that this nuisance was exaggerated, and that you found two hours afterwards nausea and all the symptoms of inhaling sulphuretted hydrogen, how would you account for that?

Witness: If any such results had occurred to me, I should have given strong testimony against the lime purification.

Then I may take it that if that was the result of a visit to Fulham, although you at the time were unconscious of a nuisance, you would be prepared to state to the engineer that that was all "bosh"?—I never used that term, sir. The engineer at Fulham is, as far as I could judge, a perfect gentleman, and I conversed as a gentleman with him. If I could trace symptoms of that kind to the use of lime, I should say, "Away with it; let us not have it," undoubtedly.

But is it possible that you might have diffused through the atmosphere sulphuretted hydrogen, to an extent not appreciable by smell, so as to make it an insufferable nuisance, but afterwards acting so as to produce the symptoms I have mentioned to you?—If you ask me if such a thing is possible, you make the range of things so large that I should be very sorry to say it was impossible, but I think it is in the highest degree improbable.

At all events, your experience was limited to one visit. I should not myself have generalized from one visit; but it is from one experiment that you draw your conclusion that there was no nuisance at Fulham?—I have given you the data upon which I have founded my opinion. I have been at other stations besides Fulham. When I went to Fulham a light wind was blowing. I went to leeward while the purifier was being opened, and my private conclusion at that moment was that, if on all other occasions the selfsame amount of care was devoted to the emptying of these purifiers, that was devoted to the one when I was there, we should have very little complaint on the part of the inhabitants of Chelsea.

Did you at that time adopt any test to ascertain whether there was any sulphuretted hydrogen present?—None, save the test that nature gave me, which is one of the finest possible.

At Fulham the purifiers are in the open air, so that, at all events, the absence of nuisance at Fulham was not due to the purifiers being covered with a shed?—I can only say that the nuisance was certainly absent. I understand from Mr. Harcourt's evidence that care had been taken to draw air down, so as to carry the foul air away, and perhaps to the withdrawal of this foul air the absence of nuisance may have been due.

Cross-examination continued: When I was at Pimlico the lime was bare and naked when shot into the barge, and the stench was wafted from that bare and naked lime to my nose. I believe that was the sole weak point in the arrangement at Pimlico. If the source of nuisance when I was there was perfectly and properly dealt with, then I should say there ought to be no nuisance at Pimlico.

Mr. POPE: I understand both you and Dr. Pole rather referred to Mr. Harcourt for suggestions. Do you think the getting out of this sulphur of any great importance?

Witness: Perhaps I can best answer that question by entirely endorsing what has been said by Mr. Harcourt. Were I offered gas with the sulphur at 3s. 9d., and the same gas without the sulphur at 3s. 11d., I should certainly, without hesitation, pay the 2d. extra for the pure gas. It is very difficult—indeed, it is perfectly impossible—to state the proportion, or express numerically, the amount of danger or damage done by impure gas.

But, if you agree with Mr. Harcourt, he is of opinion that there is no great necessity for the removal of this extra amount of sulphur. Is that your opinion or not?—I should be very sorry to attach too great importance to it; still I think it is very desirable to have the sulphur as low as it practically can be kept. At all events, from the evidence I have heard and read upon the subject, there are possibilities open, and always, I think, on public grounds, it is better to err on the safe side.

Have you given personal attention to the investigation of the gas question at all?—Will you allow me to answer that question by referring to my first appointment as a Gas Referee? I was written to by Mr. Farrer, at the instance of the late President of the Board of Trade, I think Lord Carlingford. I wrote to Mr. Farrer, saying, "I am not professionally a chemist. I am a Professor of Physics in the Royal Institution. I do not undertake to make chemical experiments of the examination of gas. I am acquainted with the process of photometry, and if any physical question should arise, I might be able to cope with such a question." Mr. Farrer wrote in reply that "that is exactly what we want; we have Dr. Pole and Mr. Harcourt, and we want a gentleman of your acquirements to meet these other cases;" and he said, "I am perfectly willing to give you my advice gratis whenever you wish to call upon me." It was almost under pressure that I accepted the office of Gas Referee. I have not made any chemical experiments with regard to gas, but I am perfectly competent to form a sound scientific opinion upon the questions that come before me.

By the COMMITTEE: I have made no experiments regarding the effect of sulphur compounds upon health, or upon the binding of books or the gilding of frames. I have made experiments, but of so restricted a character that I should not state them here as experiments of authority.

MONDAY, MAY 14.

Mr. ROUND said he had done all he considered necessary, and would now no more than watch the proceedings, and see what course his learned friends took.

The CHAIRMAN said the committee were of opinion that, so far as the existence of the smell went, they were satisfied that there was a disagreeable smell produced from some of those works, and they did not require any more evidence upon that subject. Of course, they expressed no opinion as to the cause of that smell, nor as to the possibility of curing it.

Mr. *Harry James Veitch*, examined by Mr. RICHARDS.

I have resided at 34, Redcliffe Gardens since June, 1876, and carry on business at the Royal Exotic Nursery, in King's Road, Chelsea. I have there a very large conservatory, and a very choice collection of plants. I formerly resided at my place of business in King's Road for 23 years. The acreage of my garden is 5½ acres, and I believe I am one of the largest nurserymen in the world. I have frequently observed a disagreeable smell in King's Road, when the wind comes from the south-east, which I am certain comes from the gas-works. I have seen a slight vapour arising from the purifiers when they were being emptied. I have observed that smell in my glass houses, which are as impervious to the entrance of dust as we can make them, with regard to the cultivation of plants. The smell has been the worst when the atmosphere has been thick and muggy. I do not think it possible for the dust to be carried to the houses from the gas-works. I have never detected any dust in the atmosphere coming from the gas-works. The leaves of our rare plants are so looked after that dust would be immediately detected if it was there. I do not know of illness of any sort in the family of the foreman who resides in the nursery, but the wife of one of our other foremen has on several occasions, when the smell was bad, been quite sick. My own brothers and sisters have suffered from nausea, and from headache also, but they have never been actually sick. I drew up a petition to the Kensington Vestry last year, after I went to Redcliffe Gardens to live, to which I obtained one or two signatures from my friends, and then I left it with my landlord to obtain further signatures. I believe there were about 30 or 40 signatures in all.

Cross-examined by Mr. O'HARA: The smell has been much worse within the last two or three years. My gardens are about half a mile from the gas-works.

Mr. O'HARA: You stated that you saw vapour arising from the purifiers; how did you trace the smell to those purifiers?

Witness: I am generally in my business early in the morning; and when the smell on one or two occasion recently has been very bad, I have passed into the King's Road towards the gas-works, and from the bridge which passes over the railway adjacent to those works you can see the purifiers being emptied, and when the purifiers are uncovered the vapour rises.

Why did you go to live at Redcliffe Gardens, so near the smell, if you disliked it so much?—Because I wanted a better house, and I also wished to be as near my business as I could.

As near the smell as you could?—That I cannot help; but I should like the smell to be removed.

By the COMMITTEE: I have other nurseries besides the one at Chelsea, and in driving past to them I have detected the smell. I am told it commences as early as five o'clock in the morning, according to the state of the atmosphere. Sometimes our greenhouses have been permeated almost all the day. When the atmosphere is very heavy and foggy the smell will not go off; but if the air is lighter, it passes off perhaps by nine or ten o'clock in the morning. When the wind comes from the south-east, we have had it for four, five, or six mornings consecutively. I noticed it last Wednesday, but we have not had a great deal of south-east wind lately.

We had a great deal about a fortnight ago, was it bad then?—Not so bad as I have noticed it sometimes.

Do you find the health of your plants at all affected?—It is difficult to prove that they would be affected by it. We have noticed that when the gas fumes have been prevailing in the houses, and have continued morning after morning, the plants have not lasted so long as they do when the wind comes from another direction, but to say that it is caused by the fumes of gas is more than I can do.

Do you perceive anything on the leaves?—No; we have noticed the leaves of the plants and cannot. I have tried to detect anything on the water, but I have not been able at any time to do so.

Dr. *Andrew White Barclay*, examined by Mr. MICHAEL.

I am a physician, practising in Bruton Street, Regent Street, and am Medical Officer of Health for the Parish of Chelsea. There have been numerous complaints made to the Vestry of Chelsea with respect to the nuisance arising from the gas-works. The present series of complaints commenced about 1873, and have continued up to the present time. Towards the end of 1873 I visited the works for the purpose of ascertaining what operations were being performed which might lead to the nuisance, and I found they had been obliged to resume the use of lime. At that time they were largely increasing their plant (in order to meet fresh restrictions which they gave me to understand had been placed upon them) by which they hoped that the nuisance might be prevented. The vestry appealed to the Gas Referees, who reported that they had no power to control the manufacture of gas, and then steps were taken to apply for an injunction.

Mr. MICHAEL: In the end of 1876 and the beginning of 1877 did you continue to visit the gas-works?

Witness: Yes; and agreed with the solicitors, Messrs. Lee and Pemberton, that continuous observations should be made by the residents in the parish, as to whether there was any abatement of the nuisance subsequently to the date of the Gas Referees report. I visited the works on the 14th of January this year, in company with the resident engineer, and the process of purification was explained to me, so far as it was modified up to that time. I have seen the purifiers emptied, but not very recently. I saw one of the Powell purifiers emptied in 1875, I think, and at that time sulphur compounds were given out into the air, of a noxious character, and such as, in my opinion, would be injurious to health.

Mr. MICHAEL: As far as you could judge, do you think that any want of care was exhibited by the persons who had charge of the purifiers?

Witness: I do not think any want of care was exhibited. I have always appealed to the gas engineer whether other means might not be adopted; but, not being a skilled chemist myself, I have not been able to suggest any such means. Cards have been prepared, to be distributed among a certain number of residents, in order to have an accurate report of the condition of the nuisance up to the present time; but the returns are not yet completed. That is with the intention of applying to the Court of Chancery for an injunction against the works. It must depend upon the weather how long those reports are to be continued. We must have westerly winds before we can get accurate reports. There have been several letters from the inhabitants complaining of the nuisance.

Cross-examined by Mr. O'HARA: I drew up a large sheet of paper, with a column for each day, and wanted certain observations to be filled up in a tabular form, for the purpose of ascertaining whether there was any amelioration of the nuisance or not.

Mr. O'HARA: You say that in 1875, when you were at the works, you noticed smells, and you detected sulphur compounds; that is, that you think so—you cannot say?

Witness: One can generally detect them by one's nose.

You detected these sulphur compounds. Did you consider as to whether or not the lime purification could be done without causing this smell? Did you give your mind to that at all?—I have thought it over, but I cannot say that I have come to any satisfactory conclusion in my own mind.

Cross-examination continued: I heard of the great inquiry before Mr. Forster's committee about the supply of gas to the Metropolis, but I was not summoned on that occasion.

By the COMMITTEE: I think the arrangements at the Fulham Gas-Works are rather more complete than they were, and that there is substantially an abatement of the nuisance, but unless the purifiers can be deodorized at the time of opening, I see no means by which the nuisance can be entirely abated. I cannot say that the process of passing a down draught of air has obviated it to any extent, for the reason that the gas company have been in the habit of doing so almost from the first time I visited the gas-works after the lime process was introduced. They adopted it before it was suggested to them by the Gas Referees.

Mr. *Richard Thomas Daniel*, examined by Mr. RICHARDS.

I am a Fellow of the Royal College of Surgeons in Ireland, and a Bachelor of Arts and Medicine, residing at 20, Cathcart Road, South Kensington. I was selected by the men to act as surgeon to the Imperial Gaslight and Coke Company at Fulham, in January, 1865. During the last two years I have had several complaints from the men engaged in removing the purifying material. I found them suffering from sickness, nausea, and loss of appetite. In addition to the complaints of the men, I have had frequent complaints from residents in the neighbourhood. I presented a petition last year to the Kensington Vestry upon the subject, of which vestry I am a member. The smell was at first attributed to other causes, but I satisfied myself that it proceeded from the emanations of gas. When the petition was introduced to the vestry, I moved a resolution that Dr. Dudfield should be requested to go down and report upon this alleged nuisance. He did so, and his report was sent to the Metropolitan Board of Works, to the Gas Referees, and, in fact, to all the public bodies who could bring any influence to bear upon it.

Mr. O'HARA objected to the report being read unless Dr. Dudfield was to be called.

The CHAIRMAN said he could not allow the report to be read.

Examination continued: I have resided in the neighbourhood for 15 or 16 years, and, in my opinion, the nuisance from the gas-works has very largely increased within the last two or two and a half years. When the purification was entirely by peroxide of iron, the nuisance was nothing at all compared to this. I was not aware that Dr. Letheby has stated that 1 per cent. of sulphuretted hydrogen in the air would be destructive of human life, but I should say that would be the case. In consequence of Professor Tyndall's remarks the other day, I determined to go this morning to the Fulham works, as I knew it was likely the purifiers might be opened. I left my house at six o'clock, and went straight down in the direction of the gas-works, and I did not observe the slightest smell. I went into the works, and asked the foreman when a purifier would be opened; he said in a very few minutes, as the men were just coming in to open it. I witnessed the whole process, and the stench was most intolerable. The wind was not in the direction of our neighbourhood, and the weather was very foggy, warm, and misty. I felt myself quite nauseated by the smell. I saw all the process carried out, and all the suggestions which I heard Mr. Harcourt talking of the other day; I also made inquiries, and satisfied myself that there was a down draught of air being carried through the lime. The barges and all things else were covered up, and in no way possible could this smell escape after the lime left the purifier. No suggestion occurred to my mind that would make the system more perfect.

Cross-examined by Mr. O'HARA: I went to the works because Professor Tyndall stated distinctly that he was present with his wife, and that there was no smell from the purifier, and I knew there must be some mistake, so I went to satisfy myself. I never passed a purifier from which there was not a smell, and I have passed them hundreds of times. I smelt some gas tar this morning, but it is a very different smell from that which the purifiers give off.

The COMMITTEE: Do these men complain of their eyes or hands being injured by the lime at all?

Witness: Not their eyes. Frequently, if their hands get a little moist in shovelling out the lime they get very severe burns, which are worse than burns inflicted by plain lime; they get poisoned wounds, but I have never heard them complain of the dust.

With regard to Dr. Letheby, you said he calculated that if there was 1 per cent. of sulphuretted hydrogen in the air it would be injurious to health. Does that apply to gas burnt in a close room or in the open air? How do you apply this dictum of Dr. Letheby's upon the subject?—I apply it in this way—that sulphuretted hydrogen, to persons inhaling it with other compounds, is injurious to health.

In the open air?—Yes; it fills the rooms in our neighbourhood completely, although the windows are closed. My own servants complain of it, and it has been attributed to our sewers; but I have had everything done that can be done to our drainage, and I believe it is perfect.

Mr. *Frederick Alexander M'Minn*, examined by Mr. POPE.

I have been engaged at the Fulham station for 18 years, and have been chief engineer there for two years. That station originally belonged to the Imperial Gas Company. In the summer of 1873 our directors, who were then the Imperial, became aware that the Gas Referees would very shortly place them under the particular restrictions as regards purity from sulphur compounds, which they had previously insisted upon with regard to the Chartered Company, and it was therefore necessary to commence, in anticipation of their demands, some preparation, in order to enable us to purify our gas. We made up our minds that the requisite amount of purity could be obtained only by the use of lime. It was in June, 1873, after the Referees were appointed, that the purifiers were first charged with lime at the Fulham station. As soon as we commenced using the lime process, it was found that our purifying capacity was quite inadequate for the purposes required by the Referees. It necessarily involved a frequent substitution of fresh lime, in order to purify the quantity of gas required. We did succeed in keeping down the quantity of sulphur pretty successfully from that time, but it was with very great difficulty, on account of our limited purifying area. we had to change the purifiers very rapidly. A great nuisance was certainly created. In the winter of 1873-74 a number of lights were transferred to another station, so that we might enlarge our purifiers at Fulham. On the 9th of February, 1874, I received a letter from Mr. Chubb, the secretary of the Imperial Company, enclosing a complaint from the Metropolitan Board of Works with reference to the nuisance which was being created. By the winter of 1874 it was found that it had not been possible to get all our new purifiers ready in time for the winter, and we applied to the Referees for some relief from the maximum of sulphur which they required, but they declined to make any alteration in their order. Notwithstanding that our apparatus was not perfectly completed we succeeded in purifying the gas substantially as the Referees required; but we had great difficulty in doing it. On several occasions we were above the mark, but the matter was leniently considered, by reason of our works not being actually completed. On the 28th of January, 1875, Dr. Barclay visited our works with reference to complaints of the nuisance that were being made. He especially referred to a nuisance on the 20th of the previous December, and I explained to him that it was due to our being obliged to change the purifiers rather sooner than we ought to have done, because if we had allowed the matter to go on longer, we should have had our gas above the maximum. On the 24th of August, 1875, Dr. Barclay came to the works and made further complaints of the nuisance which the district and his neighbourhood were feeling. Up to that time I had been giving every possible attention, both to secure a proper purification of the gas, and to minimize the nuisance as much as possible. Up to the end of 1875 Dr. Barclay, from time to time, visited the works, and I explained to him the system of working the purifiers by rotation, which I hoped would do away with the nuisance. I may illustrate what I mean by this [producing six cards]. We have a set of six purifiers; they are placed in this way, and we thought that by continuing the flow of gas through the whole of the series, we should be enabled to convert the lime in the first purifier into carbonate of lime, so as to prevent the nuisance caused by the sulphide of lime; but we found that by adopting that process, it drew the whole of the sulphur out in this first purifier in such vast quantities, that it was impossible to prevent it going into the gas, and therefore we had to abandon that process. In July, 1876, I received still further complaints from Dr. Barclay of the nuisance arising from the Fulham works. He came to the works, and I was extremely vexed to see him, because my impression was that I had been successful in reducing the nuisance to such an extent that it would not be noticeable. I told him exactly what I had done, and what difficulties I found—that, in truth, I could not, by the rotatory system I have mentioned, purify the gas, and at the same time avoid the nuisance. From that date, therefore, the system of working the purifiers in rotation was abandoned.

Mr. POPE: Let me ask you this, because a great deal seems to turn upon it. Did you do everything which your knowledge, care, experience, and supervision could do, to carry out this in a successful way, in order to accomplish the double result?

Witness: I did.

Honestly, with the view to do it, if possible?—Yes.

I think you say that you thought yourself you had succeeded in minimizing the nuisance?—I did.

Examination continued: In September I received instructions from our directors, in common with the other engineers of the company, to try the ventilation of the purifiers that has been mentioned by Mr. Harcourt. I have a copy of the directors order:—"That the foul lime at all stations be completely ventilated prior to removal."

Mr. POPE: How soon after that order did you proceed to apply to your purifying chambers this ventilating process?

Witness: I did not apply it further than on one occasion only. I found then that the temperature of the lime was increased to such a very great degree, and the length of time occupied in ventilating the whole of the lime would have been so great, that, in the first place, I could not open the purifier long enough, and, in the second place, I seriously apprehended damage to the vessel itself. I should also add that the nuisance caused by heating the lime was so much greater than that ordinarily caused, that I abandoned it simply on that account. After carrying the experiment on for, I think, five days, I found that I should want the purifier again for use, and I had to stop the process; and in order to get the purifier empty I had, as it were, to bribe the men to go into it on account of the terrible state the lime was in.

By the COMMITTEE: The heated condition of the lime was caused by the action of the oxygen of the air in passing down through it.

Examination resumed: I have since modified that process, and now simply carry it to the extent of removing the gas itself which remains in the purifier after it is shut off; and also, as I have always done from the introduction of the lime process, I draw the air down while the operation of emptying the purifier is going on. On the 17th of November I heard from Mr. Harcourt that, in consequence of the complaints of the Chelsea Vestry, he proposed to visit the works and inspect the process of purifying, which he did on the 22nd, in company with Dr. Pole. I showed Mr. Harcourt the whole of the arrangements that were going on—the trucks, the means of covering the lime, and the hood for shooting the trucks under; and I also showed them the means for covering the barge over to prevent the escape of dust, as far as possible. I delayed opening the purifier till the arrival of Mr. Harcourt and Dr. Pole, when the lid was raised, and the operation commenced. I mentioned that Dr. Barclay had suggested the application of chlorine gas to deodorize the lime, and I explained to the Referees how he suggested it; but they agreed with me that it was quite impracticable, and could not be carried out. Mr. Harcourt then observed that, while the men were removing the lime, there was some dust thrown up. The lime was dry—it very often is dry, but at other times it is quite moist in itself—and he suggested the application of water to the lime, as he thought that nuisance was caused by the dust escaping. I undertook to do that. Mr. Harcourt also proposed that we should cover the lime over with tarpaulins, or cloths of some sort, in order to prevent the escape of effluvium, and that I undertook to prepare for on his next visit. Before leaving, Mr. Harcourt thought over the idea that had been thrown out, about the application of chlorine gas, and then they proposed that we should try an experiment with chloride of lime; that we should take some wooden trays, and place some chloride of lime upon them. Supposing a purifier is being opened and the wind was blowing in a certain direction, the chloride of lime should be placed here [pointing on a model] and treated with an acid, so that the chlorine gas should be thrown off; and he thought that if those two gases came in contact with the air the one would deodorize the other. I undertook to do that on the next visit. I remember Dr. Pole suggesting that that would "catch it on the wing," but it did not seem to me altogether practicable to do it, because chlorine gas is a gas of very heavy gravity, and would fall quickly, whereas the other gas ascends; however, I undertook to carry it out.

Mr. POPE: Excepting the wetting of the lime and covering the surface during the discharge of the purifiers, was the whole of the rest of the process described by Mr. Harcourt in operation during the time that those complaints were being made against the stench from the works?

Witness: It was; everything was in use.

That being so, if there be any nuisance at Fulham, is it in any way due to negligence, or carelessness, or indifference upon your part, as to its existence or cure?—No, it is not. I have taken the greatest possible care that any man can to prevent that nuisance, and I am constantly supervising it.

I may ask you this question generally: Have you been able to get rid of the nuisance which is occasioned by this system of lime purification?—No.

In your opinion, is it possible to carry on a system of lime purification involving the reduction of the sulphur compounds to the extent prescribed by the Referees without causing a nuisance which may be offensive to the neighbourhood?—No.

You have exhibited no disinclination, whether natural or otherwise, to cope with this problem of gas purification?—None whatever. I have met everything that Mr. Harcourt has suggested to me most cheerfully, and endeavoured in every way to improve upon what we did before.

Mr. Harcourt seems to think that at Fulham, to do you credit, everything is done which can be done. Let me ask you, in your judgment, though everything is done which can be done, have you solved the problem at Fulham?—I have not. I suffer from it myself, and I would endeavour, if I possibly could, to remove the inconvenience for myself, if not for anybody else; but I have not been successful in doing it, although we have spent considerable sums of money in endeavouring to solve this difficulty.

In pushing the process of deodorizing the sulphide of lime to the full extent, is there any special danger which has been found in the manipulation of that process?—Yes, unquestionably a danger. The action of oxide of iron upon sulphuretted hydrogen is to form a sulphide of iron, and when the oxygen again meets with it, it re-forms the oxide of iron and precipitates the sulphur. That is in the form of uncombined sulphur, and the amount of heat evolved during that process is sufficient to ignite the sulphur. Then you have the purifier full of gas, and when you use the ventilating process you have to drive it down and pass it through the oxide, and that in itself is somewhat dangerous, by reason of its being an explosive mixture when mixed with common air. If you go on, and draw down the sulphuretted hydrogen, that, when mixed with common air, is also an explosive gas. Again, in carrying on this process, every time you do it, the heat here [pointing to the model] is sufficient to ignite the sulphur. We saw that difficulty long before the lime process was introduced, but more especially since then, because I constructed vessels, with closed covers, with a pipe to carry off the vapours other than sulphuretted hydrogen, and I put on them two large valves, in anticipation of such an accident happening as an explosion. We subsequently found, in carrying that process out at the Bromley station, that an explosion did happen there; and I then ceased using the closed vessel, and constructed this open vessel. We then introduced a steam-pipe into the oxide, the object being to moisten it, so as to endeavour to prevent the ignition of the sulphur. There is a great deal of heat given off from the purifier during the ventilation of the lime to the fullest extent, and the steam dries the

oxide to such an extent at the bottom layer that it is still liable to ignite. It becomes hot and dry, and then chemical action goes on, and the sulphur is heated, and sufficient heat is still created to cause an explosion, although you introduce the steam by way of preventing it.

As I understand, the ventilation that Mr. Harcourt spoke of in terms of praise cannot be safely carried beyond the point at which you carry it at Fulham, because of its tendency to heat the lime in the purifier itself, which, of course, renders the lime even more offensive than it is to begin with?—Yes, unless you carry it to the full extent, and completely deodorize it.

If you carry it to the full extent, then you run this risk of carrying over other sulphur compounds, and creating another smell, or an explosion, from the causes that you have mentioned, either the leakage or the heating?—Yes.

Have you therefore carried out this process of ventilation to the utmost extent that you consider it safe in your experience to follow?—Yes; seeing that I have a great number of men in my charge, I consider that I do carry that process as far as it dare be carried for the safety of the men.

Notwithstanding all that, there does exist the nuisance which you have mentioned at Fulham, and which is, to your mind, inevitable?—Yes. There is an incident I may mention. It appears to me, from all the Referees have said, that they have in their minds an idea that I do not carry out this process carefully. They always point to that, that if these processes are carried out carefully, there is no nuisance. I can only give you my honour as a gentleman that I do carry out these processes to the fullest extent; that is the most forcible way in which I can tell you. On one occasion, Mr. Harcourt came down to the works without a previous appointment, at a time when we were fully engaged in emptying a purifier. He came into the works, and went to the purifier that was being emptied. It was reported to me immediately that he came, and I was rather nettled, because I thought it implied a want of confidence that I was not carrying out these processes exactly as they ought to have been done, and I did not go to join him. I thought he might investigate as far as ever he chose. In about half an hour my foreman came to me and said that Mr. Harcourt had asked him to take a piece of lighted yarn, so that it would smoulder, and smoke, and hold it over where the lime had been removed, in order to see if the draught from the exhauster was really drawing down the air, but my foreman declined to do that. He said it was so dangerous an experiment that he dare not do so without my authority, and he came to me to ask whether he was to do it. I said that I was greatly obliged to him for not doing such an extremely dangerous thing, because there was a decided danger of a serious explosion, and it might have cut my works in half. I look upon that as an instance of the want of practical knowledge those gentlemen have in the internal economy of gas-works. A practical gas engineer would certainly never have dreamt of proposing such a trial as that. I do not desire to throw any disrespect on Mr. Harcourt in any way, or upon any of the Referees. They are no doubt able men; but I say that the practical knowledge which is so essential was absent.

Cross-examined by Sir E. Beckett: We found it very inconvenient being under the 20-grain test in the summer of 1874, because our purifying apparatus was not large enough to enable us to comply with the Referees requirements.

Sir E. Beckett: You received a letter upon the subject, did you not, from the Referees, on Nov. 14, 1874?

Witness: I do not know of any.

Sir E. Beckett said it was not very long, so he would read it:—

17, *Buckingham Street, Adelphi, Nov.* 14, 1874.

We have to thank you for your letter of the 2nd of November, giving us the information asked in our letter to you of the 12th of October, in reference to the increase your company are making in their purifying apparatus. We were desirous to obtain complete information on the facts, before reconsidering the maximum of sulphur impurity we have prescribed, and we are happy to express our satisfaction with the measures your company are taking to increase the purity of the gas supplied by them, and our sense of the difficulties which have delayed the execution of those measures.

Having now the facts correctly before us, we have carefully considered your request; and we may say at once that if we were convinced that the retention of the maximum at the present amount would press so hardly on the company as to be likely to subject them to fine through the fact of the accidental non-completion of the new apparatus, we should be disposed to make a relaxation in their favour. But on carefully considering the data before us we cannot come to that conclusion. In the first place, looking at the sulphur returns of last winter, we find that, although the maximum then in operation was 30 grains, the actual amount did not often exceed 25 grains. The principal exception occurred at the Haggerston works in December, and at Fulham during the other half of the same month.

In the following month, owing, no doubt, to increased experience in the management of lime, although the make of gas had scarcely at all diminished, a maximum of 28 grains was never exceeded at Haggerston, and on three occasions only at Fulham. At the St. Pancras works the same maximum was exceeded twice only in each of the four winter months. Since that time two advantages have accrued to the company, which should enable them to supply gas of a somewhat higher degree of purity than last winter—first, the opening of the spacious works at Bromley, which enables them to transfer a portion of their make from works, the demand on which has outgrown the means of purification, to a place where every facility should exist for the reduction of sulphur to the lowest point; and, secondly, the experience gained not only from the experiments specially instituted by the company on the subject (as named in your letter), but from a year's working of a method of purification, which, even where imperfectly applied, reduces the amount of sulphur considerably below 25 grains. A comparison of the returns of the present year with those of the corresponding period of last year shows very much improved results, which (as there has been no increase of purifying apparatus brought into use at the urban stations) we can only attribute to increased knowledge, care, and skill in the mode of purification.

In the month of October, 1874, the maximum amount of sulphur returned was—

	Grains.
At Fulham	17·6
At St. Pancras	19·3
At Haggerston	18·2
At Bromley	15·4

(excepting two days, on which they were quite anomalous, and evidently accidental). In November the maxima have been—

At Fulham	16·1
At St. Pancras	13·1
At Haggerston	17·1
At Bromley	10·3

The averages have been as follows:—

	Oct., 1874.	Nov., 1874.
Fulham	15·6	14·8
St. Pancras	15·4	12·0
Haggerston	15·2	15·6
Bromley	10·4	7·3
General average	14·1	12·4
The average for the corresponding months of last year were	18·2	20·5

Hence it is clear that your managers are employing their existing purifiers much more successfully than at the corresponding periods of last year, and although the make is approaching its maximum they are keeping a long way below the prescribed maximum of sulphur. At Bromley, judging by the very low sulphur returns, there can be no reasonable doubt of the sufficiency of the purifying capacity; and at St. Pancras four out of six new purifiers are so far advanced that they may certainly be used before the depth of the winter. These two works yield nearly half the supply.

From these data we cannot doubt the power of your engineers, by skill and care, to keep during the winter within the present maximum under ordinary circumstances. It must be borne in mind that if it should be exceeded, owing to extraordinary contingencies, you have your power of appeal, and we have no doubt that in such a case the chief gas examiner would take into consideration any *bonâ fide* plea on your part founded on temporary difficulties arising out of the non-completion of the new apparatus.

You must, we are sure, be aware that the raising of the maximum would be viewed with great displeasure by the public, and it is consequently a step we could not resolve on, except under more urgent necessity on the part of the companies than we at present see. The public may reasonably expect a lowering of the amount of sulphur, now that the practicability of keeping it down has been established; and we hope that next year we shall be able to fix a lower maximum than heretofore.

We take this opportunity of expressing our satisfaction at finding that purification by lime has been carried on at Fulham during the summer without a repetition of the former complaint of nuisance to the neighbourhood. We were confident, at the time you brought this matter before us, that such a result might be achieved by care and skill on the part of your managers, and we are pleased to find that our anticipations have been realized.

That letter was signed by the Referees. (To witness:) Do you wish to make any remark upon that?

Witness: With regard to the question of sulphur, that is not the point at all. We have complied with the Gas Referees instructions entirely upon that.

Sir E. Beckett: What do you say to the last paragraph?

Witness: I do not understand it. I never heard of the letter before.

Then Mr. Chubb did not think it worth while to communicate with you about it?—I do not know; I cannot tell you what was in Mr. Chubb's mind.

Then we must ask Mr. Chubb. Did you take any part in the proceedings in 1875 before Mr. Forster's committee?—I had nothing whatever to do with that matter at all. I was devoting my attention to suppressing the nuisance, although unsuccessfully.

If these Referees continue—or better Referees, if you would like to have some better—you would go on trying experiments to get rid of the nuisance?—I consider, so far as the lime process is concerned, that I have done everything that can be done, and the Referees agree with me.

When you say everything has been done that can be done, do you mean, to repeat Mr. Forster's question in 1875, that science is never going any further?—No.

If the Referees continue requiring you to keep down the sulphur, will not you go on continuing to try fresh experiments in order to do so?—Not after this lime process. My mind is made up on that point; I have brought it to the practical limit. I cannot improve on the experience that I have had, and I am not aware of any other process.

Everything must have a beginning. Will you take upon yourself to say you are satisfied that science can never find anything?—They may discover something a hundred years hence.

Supposing you are under two fires, the Referees on the one hand and the penalties on the other, do you not think it would be worth while going on, and possibly paying scientific men to try and invent some process?—I hardly think you mean that it would pay anybody to try and invent a process.

Such things have been done in the world?—It seems such an extraordinary question, that I find some difficulty in answering it.

It is an unpleasant question, no doubt?—It is a myth. I cannot define in my own mind how I am to set about giving a practical answer.

Mr. Pope: Then you think it is fair to say that we are to be put under penalties until somebody can invent something to get rid of the lime process.

The Committee: Mr. Harcourt told us that these limits depended entirely upon the lime process.

Sir E. Beckett: I want to know whether this gentleman is confident that nothing more can be done by way of improving the lime process to get rid of the nuisance?

The Committee: The question to Mr. Harcourt was to that point, and he said if purification proceeded upon any other process the limit would have to be temporarily abandoned.

Sir E. Beckett: Then he would abandon it. (To witness:) If, on the other hand, this Bill is passed, relieving you from the Referees, what motive will you have to try and purify the gas and get rid of the sulphur?

Witness: If we possibly could discover a process, we should. I have lately been trying experiments myself with that view—we are constantly doing so; and if we were to eventually discover such a process, we should, of course, adopt it.

Why "of course," without any Referees?—Simply we should, as we always have done, be doing our best to carry out the intention of reducing the amount of sulphur in the gas; but I have no grounds for saying there will be a success. The experiments I tried are entirely abandoned, and I do not at present know any other direction in which to make them.

Supposing the Referees are removed, as this Bill tries to do, what motive will you have for taking any trouble to find the means for removing the sulphur?—At the present moment I do not see what motive there is other than the endeavour to reduce the amount of sulphur in the gas supplied to the public.

Do you think there is any harm in sulphur as burnt in a room?—To what amount do you mean?

What amount of sulphur would you like—say 40 grains?—I do not think there is any practical difference between 20 and 40 grains.

You would not think it worth while to try and reduce the sulphur below 40 grains if you were free from penalties?—I say practically there is no difference between the quantity of sulphur at 20 and grains 40.

That being your opinion, would you take any trouble to reduce the sulphur below 40 grains if you were free from penalties?—If we had a process by which we could do it I would, but it is a question I cannot answer, because there is no process but the lime.

Mr. Pope: We take it for granted that if there were no penalties, practically 40 grains would be the maximum.

The Committee: Is there any amount of these sulphur compounds which is ever produced by the combustion of gas which you think would be injurious, because you speak of the difference between 20 and 40 as not being worth considering?

Witness: Not between 20 and 40; but if it went as far as 60 or 80 grains, or anything like that, I should be inclined to think it was decidedly advisable to remove it, because there would be a greater amount of sulphurous acid formed in the same amount of air in the room, the effect of which would be simply a question of disagreeableness in the room. So far as the injury to health goes, I think, even in that case, it would not be so in an ordinary ventilated room.

Is there much more difference between the injurious effect produced by 40 grains as compared with 60, than there is as between 40 grains as compared with 20?—It would increase in the same ratio as between 20 and 40 and 40 and 60.

You have thought 40 grains about the happy mean at which you begin to allow it to be injurious?—I think 33 grains was the average quantity of sulphur existing in the gas under the oxide process. I have looked at it in this light, that sulphurous acid is a disinfectant, in point of fact; and it struck me whether or not it is not an advantage, to some extent, to have sulphurous acid. It may seem to be a laughable thing, but sulphurous acid is, nevertheless, a disinfectant.

Would you be quite satisfied to have a limit of 33 grains?—No; because it is a process that we cannot exactly control. It never reaches more than 40 grains, but it will range between 28 and 30 and 33 grains when the purification is carried on by oxide of iron.

In July, 1876, you had the impression that you had succeeded in doing

away at that time with the nuisance; what did you form that impression from?—Through the means I adopted there, I thought I had reduced it to such a low degree that it would not be observable; or, if so, not sufficiently to draw forth complaints.

Is it observable in the yard at the present time, when there are complaints in the neighbourhood?—Yes; it is more noticeable on a damp, dull, wet morning; such a morning as this.

If it were noticed outside, I suppose there is no doubt you would notice it inside the works still more?—That would depend upon the condition of the atmosphere. If it was a bright, light, clear day, with a westerly wind, it would rise and go away, and be noticeable more at a distance than on the works, perhaps.

Have you made any suggestion to the referees that, instead of fixing a limit of 20 grains and 25 grains, they should give you an average of 33 grains?—No; we have not put it in that way, except that we have proposed that there should be no limit fixed.

But supposing you could not get that?—We were willing to take 40 grains; but we could not accept 33 grains as the maximum.

Supposing you had more room in your yard, and were, therefore, to have a greater number of lime purifiers, would not that reduce the nuisance very much?—No, I think not; because you have to take out a certain impurity—the bisulphide of carbon; and in order to do that you must have sulphuretted hydrogen and sulphide of lime. If you do not take it out it goes into the gas. Therefore you must remove the sulphide of lime, drawing with it the bisulphide of carbon, and if that has to be reduced to a certain point, no matter how, you must take it out.

Is it not the case that the oftener you change this lime, the oftener you open the purifiers, and the more rapidly you work, the worse is the smell in the neighbourhood?—If the capacity of the purifiers is not sufficient to reduce properly the sulphur compounds, they must be changed oftener. We have always done so in the summer to the fullest extent, and we are now increasing our purifying plant very largely to enable us to do it during the other months. But you still have to take out the same quantity of bisulphide of carbon, and you must have the sulphide of lime to do that; and if your purifiers are larger, the only difference is that you work them somewhat longer. You are able better to combine the sulphur compounds that have to be removed—that is, the velocity of the gas is less, and it is longer in contact—but, in point of fact, the more you purify the gas absolutely the more nuisance you must create, because you bring more impurity out.

What we want to get from you is this: Supposing you had more space, and a greater number of purifiers, would not that lessen the nuisance, both by the infrequency of opening the purifiers, and also because you would not have to force the gas through so rapidly?—It would lessen the frequency with which we should have to change the purifiers.

You also say if you have to force the gas very fast through the purifiers the effect is worse, so that in those two respects you gain an advantage?—We have an advantage—that is the reason why we have spent so much money in extending our purifying plant, and are proposing further extension.

That would, to some extent, reduce the smell?—In the very depth of winter it would reduce the frequency of changing the purifiers, but at the same time the bulk of lime is larger, and the operation of changing a purifier extends over a longer period; therefore, in point of fact, you have to perform precisely the same work, but in a slightly different way.

In cross-examination by Mr. Round, witness expressed his opinion that the foreman at the works had acted correctly in declining to hold a piece of lighted yarn over the purifiers, as requested by Mr. Harcourt, on account of the possibility of an explosion. He also stated that the foreman, although he had no scientific knowledge whatever, was in that particular case the better man of the two, because he had the practical knowledge. The danger of explosion would be from the valves, of which the foreman was thoroughly aware.

Mr. Round: This ventilating of the purifier had been going on for some time, had it not? The air had been drawn down through it for all that time, and Mr. Vernon Harcourt knew perfectly well that it was not inflammable, though you set against that the opinion of your foreman, who thought it was?

Witness: I undertake to say that it is most probable that there would be slight leakages from the valves at the bottom of the purifier, which were covered over by the layers of lime, and were not noticeable; and with this down draught, if a spark had been carried down, the gas would have gone below the layer of lime and have caused an explosion.

The operation of drawing down the air had been going on in the open air for hours; it was not covered?—It is open to the air, but the draught is drawing inwards.

Supposing it had resulted in an explosion, Mr. Harcourt would have been the first person to have been blown up?—Yes, and the men occupied in clearing out the purifier. Mr. Harcourt did not know of those two valves, but my foreman did, and he would not allow the trial to be made.

Sir E. Beckett: Then you would have had a new Referee?

Witness: I should have preferred to have a practical gentleman to see my works.

Mr. Round: You give this decided opinion that an explosion would be the consequence?

Witness: Might have been the consequence, because there would be sulphuretted hydrogen as well escaping.

Mr. Richards: Will you ask the witness whether a bit of fluff would not have shown the down draught just as well.

The Chairman: That is not the question.

Mr. Round: You would have the best possible means of seeing, by the smoke, whether there was a down draught or not.

Witness: Supposing an explosion had happened, and had interfered with one of those purifiers, and put it out of use, my works would have been cut in half. It was in mid-winter, too, and that would have been a very grave and serious matter.

One of the two cases may then be apprehended. Possibly an explosion from the presence of a small portion of sulphuretted hydrogen?—Not altogether.

You have alluded to leakage as one cause, but the other was sulphuretted hydrogen coming in contact with the air, and becoming explosive?—Sulphuretted hydrogen is an inflammable gas.

What proportion of sulphuretted hydrogen must there be escaping as compared with the air?—I cannot tell you what proportion. There must be an explosive proportion.

Now we know the extent of your chemical knowledge. I only wanted to know, before you gave your opinion, whether you were acquainted with the A B C of chemistry?—You have no means of ascertaining how much sulphuretted hydrogen is being given off.

We can judge of that theoretically. What must be the proportion of the one to the other before it explodes?—It is impossible to discover that.

Without reference to these particular circumstances, what proportion of sulphuretted hydrogen must be mixed with the air to cause it to explode?—I forget at the present moment, but that it does explode is quite certain; and in addition to that there was the escape of gas from the valves. I particularly mention that more than the sulphuretted hydrogen.

Mr. Round said there was a letter he wished to lay before the committee which Mr. Vernon Harcourt had accidentally taken away on the previous Friday. It was from Mr. Evans, dated the 28th of October, and he was merely going to read a passage, and ask the witness whether he agreed with it. Mr. Evans wrote to Mr. Vernon Harcourt as follows:—

My dear Sir,—In reply to your letter of the 26th on the subject of ventilating foul lime, I am quite certain, had you seen the process in operation properly, you would not have condemned it as you did by attributing the nuisance to its use. The ventilation of foul lime is not new to me. I adopted it at the Berlin works (I think 38 years since), and it worked admirably, and entirely got rid of the nuisance of foul lime.

(To witness:) Do you agree with that or not?

Witness: I do not know what Mr. Evans experienced 38 years ago, but I should judge that the works must have been of a very small size. I understand what Mr. Evans means there is the process, to the full extent, of ventilating the lime; but then you are dealing with 38 years ago, and, no doubt, with very small works. You have to deal here with very large bulks of lime indeed, and that is a great and essential difference.

Mr. Round: I am told I ought to read the next sentence:

In the year 1846 it was adopted at the Westminster station at an outlay of £2000 or £3000, and was only given up on my discovery, accidentally, of the renovation of oxide of iron.

We know that oxide of iron is passed away and done with as a purifier, and that was the only reason why it was given up. Do you agree with Mr. Evans as far as that goes?

Witness: I do not know what was the size of the Westminster works at that period, or what foul lime Mr. Evans had to deal with. I only judge from my own experience of the present bulk of lime we have to deal with. In carrying out the experiment of drawing air down through the lime, I was obeying the instructions contained in the directors minute, but I do not know how the matter originated.

Is the exhauster which was used to produce the down draught of air connected with more than one set of purifiers?—It is connected with the whole.

I suppose you often have to open more than one purifier at a time, have you not?—We have sometimes in the winter to open two at the same time.

When that is the case, and when you have to open two at a time, is it not possible that the action of the exhauster might be limited to that one which presents the least resistance to the down draught of air?—When the sieves of the purifiers are exposed, the air will go through them instead of through the lime, which offers a great resistance; but, notwithstanding that, I have still been obliged to stop the exhauster before being able to empty the bottom tray of the purifier, on account of the heating of it.

Occasionally, will it not happen that one of the purifiers is being discharged without the protection that the down draught of air gives it?—No.

To a certain extent it would be deprived of it?—It is exactly the same thing, if you are only opening one purifier. As soon as you expose it, whether it is one or two, the air goes through the opening immediately, without touching the remainder of the lime; it takes the easiest passage for itself.

When you were discharging the purifiers, was the exhauster always left in action, previous to the time when the Referees came?—Yes. I think I have explained to Mr. Harcourt what I have done.

Mr. Michael said he proposed to read the reply of the Referees to that letter from Mr. Evans.

Mr. Vernon Harcourt: Then I think the whole of Mr. Evans's letter should be read.

Mr. Round: Very well. I will take it up from the point where I left off.

We had for years previously been in the habit of burning refuse lime in an oven, and reusing it for purification, so as to diminish the amount of material to be removed; all this was expensive, and was got rid of by the use of oxide of iron. I believe this to be so far the best method of purification; but then you three gentlemen say that we must reduce the sulphur in the gas by some 8 or 10 grains, not, I believe, from any conviction of its necessity, but simply to meet not even the outcry of those who burn the gas, but of a few agitators in the Board of Works and the City Corporation. Now, when I was a Referee, I steadily refused to impose conditions on the gas companies which I knew were uncalled for and absurd, and resigned my appointment, worth £700 per annum, before I would be a party to what I considered a direct departure from the spirit of my appointment.

I venture to suggest that the sulphur question is a bugbear raised by Letheby who found it pay to keep it up. It is all very well to say there is no nuisance from foul lime. I contend there is, and when the time arrives when some of our people are killed (and many are often rendered incurable now) a coroner's jury may bring in an awkward verdict against our engineers for using this process. In little works, as at Silvertown, the purifiers are small, and easily and quickly changed; but when you have to deal with 800 to 1000 bushels of refuse material, it is quite another affair. It is like the earth closets for a small village, and its application to London or any large city.

In a sanitary view, I believe, a little sulphurous acid would do good, but you will never get enough to do any good from the combustion of coal gas, even with 40 grains. It is a curious fact that these few grains of sulphur appear to have a wonderful effect, while nothing is said about the carbonic acid produced by the combustion of a foot of gas (nearly one foot), and yet this is, after all, the great source of evil, where gas is burnt without a proper ventilation of the room. All this should be shown up to the public, and it was my intention of so doing had I remained in office. I trust, however, the day is not far distant when we shall get rid of this lime nuisance, which at present is a thousand times greater than that the sulphur in gas produces.—I remain, &c.,

F. J. Evans.

Mr. Michael: The following is the answer, witten Dec. 30, 1876:—

My dear Sir,—I am obliged by your letter of the 28th. I attributed the nuisance at Shoreditch mainly to the nuisance of the ventilating process, and I did so in consequence of what you and Mr. Clark told me of the peculiarly nauseous smell which had there resulted from the overheating of the purifying material, and which you attributed to the action of heat on naphthaline. By all means introduce this process at all your works if you have not already done so. I have seen it at work on several occasions, and have never myself seen any approach to an overheating of the lime, or of the oxide through which the air is expelled. By keeping the lime damp, and drawing enough air through it, I believe the ill effects on the workmen and the nuisance to the neighbourhood, may be altogether avoided. I regret, however, as you do, the disuse of oxide, which I regard as far the best agent for removing sulphuretted hydrogen.

You have three impurities to remove—sulphuretted hydrogen, for which oxide should be used; carbonic acid, which needs lime, unless Hills's process proves to be better (or unless it should pay better to leave the carbonic acid in, and make up for the loss of illuminating power by a large dose of cannel); bisulphide of carbon, which can be removed by lime fouled for the purpose, and needing only to be changed at considerable intervals.

Your estimate in the difference of the amount of sulphur, according as the gas is purified with oxide only, or with lime as at present, at 8 or 10 grains, surprises me. The present average is about 15 grains; the average with oxide is between 30 and 35 grains; the difference is from 15 to 20 grains. Which of the three statements do you dispute, or how comes your estimate to be half of mine?

I have read with satisfaction the Bill which you are about to introduce for abolishing the sulphur maximum, because if this obligation is to be taken off the companies it should be by the action of Parliament. It is the manifest intention of your present Act that you shall do two things—first, remove sulphuretted hydrogen wholly; secondly, remove other sulphur as far as practicable, within reasonable cost or difficulty, and without occasioning a nuisance. I think the Referees duty is not to judge whether the reduction of sulphur is desirable, but how far, being desirable, it is practicable.

Very truly yours,

A. Vernon Harcourt.

By the Committee: By the oxide process the lime would remove the carbonic acid after the sulphuretted hydrogen had been removed by the oxide. There is no sulphate of lime formed there.

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